PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Investigation Report for MSU Mankato, Part 1

Minnesota
STATE COLLEGES
& UNIVERSITIES

MINNESOTA STATE
UNIVERSITY
MANKATO

6/12/2012

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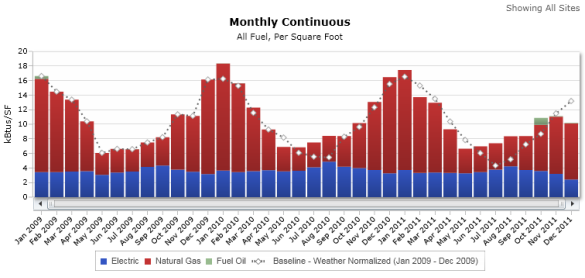
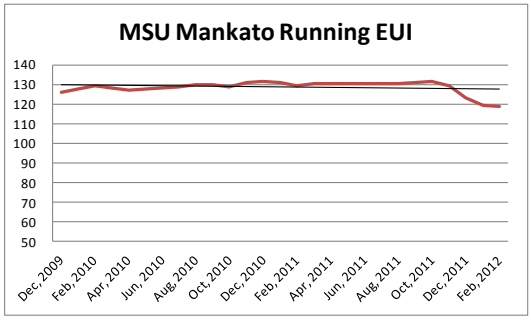
Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of MSU Mankato (Part 1) was performed by Hallberg Engineering, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total Project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$157,734		Total Project Cost	$237,154
Future costs including Implementation , Measurement & Verification	$79,420		Study and Administrative Cost Paid with ARRA Funds	($160,734)
Total Project Cost	$237,154		Utility Rebates	($54,725)
			Total costs after co-funding	$24,695
Estimated Annual Total Savings ($)	$84,657		Estimated Annual Total Savings ($)	$84,657
Total Project Payback	3.0		Total Project Payback with co-funding	0.3
Electric Energy Savings	**7.3%**	**and**	**Gas Energy Savings**	**7.4%**
(prorated for the energy use of these buildings)				





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cos Rate $ /kBtu
2009	365	2,717,428	349,248,475	349,248,475	0	0%	$3,780,574.54	$0.01
2010	365	2,732,462*	364,369,222	337,549,124	26,820,099	8%	$4,021,569.06	$0.01
2011	365	2,768,463	341,263,886	331,454,953	9,808,933	3%	$3,704,143.84	$0.01

MSU Mankato Consumption Report

The energy use at MSU Mankato dropped approximately 2% over the period of the investigation.

Summary Tables

Facility Name	Minnesota State University Mankato
Location	118 Wiecking Center Mankato, MN 56001
Facility Manager	Mike Lexvold Physical Plant Director
State's Project Manager	Ron Fields Assistant Vice President for Facilities Management
Number of Buildings Investigated	10
Interior Square Footage Investigated	898,247
PBEEEP Provider	Hallberg Engineering
Annual Energy Cost	$1,263,113 (34.1% of 2011)
Utility Company	Electric: Xcel Energy Natural Gas: Center Point Energy Fuel Oil: Unknown
Site Energy Use Index (EUI)	129 kBtu/ft^2 (start of study) 119 kBtu/ft^2 (end of study
Benchmark EUI (from B3)	148 kBtu/ft^2

Building Name	State ID	Building Type	Area (ft^2)	Year Built
Armstrong Hall	E26071S0663	Academic	143,966	1964
Centennial Student Union	E26071S8066	Student Union	210,388	1967
Ford Hall	E26071S5465	Academic	66,783	2008
Memorial Library	E26071S0865	Library	166,181	1967
Memorial Library Addition	E26071S2090	Library	80,184	1992
Morris Hall	E26071S0966	Academic	44,325	1968
Nelson Hall & Addition	E26071S0460	Academic	64,693	1962/79
Utility Plant	E26071S0560	Mechanical	10,442	1962
Wiecking Center	E26071S0158	Academic	98,224	1959
Wiecking Shop Bldg	E26071S1583	Academic	13,061	1987

Mechanical Equipment Included in Investigation: Summary Table	
Total	**Equipment Description**
3	Building Automation Systems (Andover and 2 independent Johnson Controls Metasys)
52	Air Handlers
339	VAV Boxes
48	Exhaust Fans and Power Roof Ventilators
27	Unit Heaters
3	Make-up Air Units
6	Chillers
5	Cooling Towers
4	Steam Boilers (dual fuel- natural gas or fuel oil)
1	Electric Boiler
45	Pumps (HW, CHW, etc)
2	Heat Exchangers
1,400	Approximate number of points for trending

Implementation Information			
Estimated Annual Total Savings ($)	7.4 % Savings		$84,657
Total Estimated Implementation Cost ($)			$79,420
GHG Avoided in U.S Tons (CO2e)			1,033
Electric Energy Savings (kWh) (2011 Usage 11,434,962 kWh)*	7.3 % Savings		838,614
Electric Demand Savings (2011 Peak kW 1,860 kW)			0
Gas Energy Savings (Therms) (2011 Usage was 762,624 Therms)*	7.4 % Savings		56,815
Statistics			
Number of Measures identified			20
Number of Measures with payback < 3 years			15
Screening Start Date	09/21/2010	Screening End Date	10/12/2010
Investigation Start Date	1/6/2011	Investigation End Date	4/25/2012
Final Report	5/23/2012		

Minnesota State University Mankato, Part 1 Cost Information			
Phase		**To date**	**Estimated Future Cost**
Screening*		$12,893	
Investigation [Provider]		$131,000	
Investigation (CEE)		$10,841	$1,000
Implementation			$79,420
Implementation [CEE]			$1,000
Measurement & Verification			$1,000
Total		$154,734	$82,420

Co-funding Summary	
Study and Administrative Cost	$160,734
Utility Co-Funding - Estimated Total ($)	$54,725
Total Co-funding ($)	$215,459

*Screening costs have been prorated between Parts 1 and 2 on square footage (54% for Part 1).

MSU Mankato Overview

The energy investigation identified 7.4% of total energy savings at MSU Mankato with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at MSU Mankato include adjusting equipment schedules to match actual occupancy period in buildings, adjusting set points, adjusting temperature resets and a number of maintenance related items. In addition there are a large number of recommendations, such as using boiler stack heat recovery, that may lead to significant energy savings but do not pay back within 15 years based only on energy savings. The total cost of implementing all the approved measures is $79,420. Applying the Xcel Energy study rebate of $54,725 reduces the implementation cost to $24,695 with a payback of less than 4 months.

Implementing all these measures can save the facility approximately $84,657 a year. In addition to the 7.4% savings that these measures will lead to, we note that during the period of the PBEEEP investigation energy use at MSU Mankato decreased approximately 2% compared to the year prior to the study. It is now 20% below the benchmark value according to the Minnesota Benchmarking and Beyond database (B3).

Minnesota State University (MSU) Mankato is comprised of 34 buildings ranging in size from 500 to 241,406 square feet. The total area of the buildings on the campus is 2,767,715 square feet. The campus has eleven office and/or classroom buildings, four housing buildings, a performing arts center, a utility plant, six storage buildings, an athletic complex, a field house, a library, a science center, a stadium, and a student union. Many of the buildings are attached to other buildings via open hallways or are additions to buildings. All of the buildings are located on campus, covering an area approximately eight blocks wide by five blocks long.

Mechanical Equipment

The Utility Plant contains both the central steam plant and the central chilled water plant for the campus. There are four steam boilers that provide 150 psi steam to the entire campus year-round. The steam from the central steam plant is routed to the buildings in underground tunnels. Some of the buildings have heat exchangers that transfer heat from the steam to hot water while some of the buildings use the steam directly to heat the spaces. All of the recommended buildings use steam from the heating plant. The Chiller Plant houses three water-cooled chillers. Each chiller has a cooling tower located outside of the building. There are three constant volume primary pumps and two variable volume secondary pumps that circulate water throughout the campus to the buildings. There is also an air-cooled chiller in Ford Hall and two water-cooled chillers in Memorial Library. The two chillers in Memorial Library contribute to the central chilled water loop, but they rarely operate. All of the recommended buildings use chilled water from the chilled water plant.

Controls and Trending

There are three automation systems that control the equipment in the buildings on campus. There is an Andover system, which controls Trafton Science Center (North, South, and Center). There are also two Johnson Controls Metasys systems; one controls Sears and Ford Hall, the other controls the rest of the buildings on campus. The automation systems are capable of trending and the data can be exported in a usable format for spreadsheet analysis. The points for each building in the automation system are listed in the building summary tables below.

Lighting

The majority of interior lighting on campus is 32 watt T8s.

Findings Summary

Site: MSU Mankato

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Armstrong Hall	AHU Runtime Reduction	$1,128	$21,796	0.05	$0	0.05	261
1	Memorial Library	AHU Runtime Reduction	$1,044	$22,026	0.05	$0	0.05	246
1	Centennial Student Union	AHU Run Time Reduction	$1,128	$7,219	0.16	$0	0.16	70
1	Nelson w/addition	AHU/RTU Runtime Reduction	$1,004	$3,594	0.28	$0	0.28	42
1	Utility Plant	Chillers are staged based on percentage of load in lieu of actual demand.	$2,304	$6,498	0.35	$0	0.35	103
1	Wiecking Center	AHU Run Time Reduction	$1,128	$2,513	0.45	$0	0.45	25
7	Armstrong Hall	Equipment is enabled regardless of need, or such enabling is excessive.	$1,968	$2,844	0.69	$0	0.69	54
13	Utility Plant	Chiller Condenser Water Pump CP-3C	$2,592	$2,630	0.99	$0	0.99	42
4	Armstrong Hall	Supply Air Temperature Reset is not implemented or is sub-optimal	$3,066	$2,337	1.31	$0	1.31	17
3	Memorial Library	AHU Supply Air Temperature Reset	$2,976	$1,672	1.78	$0	1.78	12
1	Morris Hall	SF-1 Runtime Reduction	$1,004	$551	1.82	$0	1.82	5
5	Nelson w/addition	Reheat Pump Runtime Reduction	$1,004	$548	1.83	$0	1.83	8
2	Memorial Library	AHU Optimize Economizer	$1,044	$519	2.01	$0	2.01	7
2	Armstrong Hall	Optimize Economizer	$1,044	$440	2.37	$0	2.37	5
5	Armstrong Hall	The steam control valve is leaking steam	$3,066	$1,063	2.88	$0	2.88	10
4	Memorial Library	Reheat Pump Runtime Reduction	$2,976	$560	5.31	$0	5.31	8
1	Ford Hall	Exhaust Fan Volume Reduction	$43,988	$7,245	6.07	$0	6.07	109
3	Centennial Student Union	Reheat Pumps Runtime Reduction	$2,976	$341	8.74	$0	8.74	4

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Site: MSU Mankato

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	Wiecking Center	AHU Supply Air Temperature Reset	$2,976	$211	14.11	$0	14.11	2
2	Morris Hall	SF-1 Optimizer Economizer	$1,004	$50	19.95	$0	19.95	1
		Total for Findings with Payback 3 years or less:	**$25,500**	**$76,251**	**0.33**	**$0**	**0.33**	**910**
		Total for all Findings:	**$79,420**	**$84,657**	**0.94**	**$0**	**0.94**	**1,033**

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MSU Mankato Phase 1

Finding Type Number	Finding Type	Relevant Findings	Looked for, Not found	Not relevant
a.1 (1)	Time of Day enabling is excessive	3	4	
a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	4	3	
a.3 (3)	Lighting is on more hours than necessary.		7	
a.4 (4)	OTHER_Equipment Scheduling/Enabling		7	
b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	4	3	
b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		7	
b.3 (7)	OTHER_Economizer/OA Loads		7	
c.1 (8)	Simultaneous Heating and Cooling is present and excessive		7	
c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement		7	
c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints		7	
c.4 (11)	OTHER_Controls		7	
d.1 (12)	Daylighting controls or occupancy sensors need optimization.		7	
d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.		7	
d.3 (14)	Fan Speed Doesn't Vary Sufficiently	2	5	

d.4 (15)	Pump Speed Doesn't Vary Sufficiently	1	6	
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	1	6	
d.6 (17)	Other_Controls (Setpoint Changes)		7	
e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal		7	
e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal		7	
e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	3	4	
e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	2	5	
e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal		7	
e.6 (22)	Other_Controls (Reset Schedules)		7	
f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit		7	
f.2 (24)	Pump Discharge Throttled		7	
f.3 (25)	Over-Pumping		7	
f.4 (26)	Equipment is oversized for load.		7	
f.5 (27)	OTHER_Equipment Efficiency/Load Reduction		7	
g.1 (28)	VFD Retrofit - Fans		7	
g.2 (29)	VFD Retrofit - Pumps		7	
g.3 (30)	VFD Retrofit - Motors (process)		7	

g.4 (31)	OTHER_VFD		7	
h.1 (32)	Retrofit - Motors		7	
h.2 (33)	Retrofit - Chillers		7	
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)		7	
h.4 (35)	Retrofit - Boilers		7	
h.5 (36)	Retrofit - Packaged Gas fired heating		7	
h.6 (37)	Retrofit - Heat Pumps		7	
h.7 (38)	Retrofit - Equipment (custom)		7	
h.8 (39)	Retrofit - Pumping distribution method		7	
h.9 (40)	Retrofit - Energy/Heat Recovery	1	6	
h.10 (41)	Retrofit - System (custom)		7	
h.11 (42)	Retrofit - Efficient Lighting		7	
h.12 (43)	Retrofit - Building Envelope		7	
h.13 (44)	Retrofit - Alternative Energy		7	
h.14 (45)	OTHER_Retrofit		7	
i.1 (46)	Differed Maintenance from Recommended/Standard		7	
i.2 (47)	Impurity/Contamination		7	

i.3 ( )	Leaky/Stuck Damper		7	
i.4 ( )	Leaky/Stuck Valve	2	5	
i.5 (48)	OTHER_Maintenance		7	
j.1 (49)	OTHER		7	

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**
	• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**
	• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**
	• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**
	• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**
	• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**
	• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**
	• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**
	• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**
	• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**
	• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**
	• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**
	• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**
	• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**
	• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**
	• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**
	• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**
	• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**
	• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**
	• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**
	• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**
	• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**
	• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**
	• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**
	• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**
	• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**
	• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**
	• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**
	• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**
	• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**
	• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**
	• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**
	• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**
	• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**
	• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**
	• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**
	• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**
	• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**
	• Please contact PBEEEP Project Engineer for approval

Findings Summary

Building: Armstrong Hall
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU Runtime Reduction	$1,128	$21,796	0.05	$0	0.05	261
7	Equipment is enabled regardless of need, or such enabling is excessive.	$1,968	$2,844	0.69	$0	0.69	54
4	Supply Air Temperature Reset is not implemented or is sub-optimal	$3,066	$2,337	1.31	$0	1.31	17
2	Optimize Economizer	$1,044	$440	2.37	$0	2.37	5
5	The steam control valve is leaking steam	$3,066	$1,063	2.88	$0	2.88	10
	Total for Findings with Payback 3 years or less:	**$10,272**	**$28,480**	**0.36**	**$0**	**0.36**	**348**
	Total for all Findings:	**$10,272**	**$28,480**	**0.36**	**$0**	**0.36**	**348**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Armstrong Hall

FWB Number:	13301	Eco Number:	1
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	AHU Runtime Reduction	Date Identified:	3/9/2011
Description of Finding:	In review of the scheduling and trend data for the AHU, found that the AHUs is running 24/7/365 for SF-1 and SF-2 (ECO-1 and ECO-6)		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Review of current Trending data for AHU		
Measure:	Reviewed building schedule with Owner to determine actual occupancy. New schedule will need to be added.		
Recommendation for Implementation:	A schedule will be initiated on SF-1 and SF-2 to shut down the units when there is no occupancy in the building. There will be two schedules. During regular school session from August 24 to May 5 the units will run from 7 AM to 9 PM Monday through Thursday, 7 AM to 4 PM on Friday, 8 AM to 2 PM on Saturday, and off on Sunday. During summer session from May 6 to August 23 the units will run from 8 AM to 4 PM Monday through Friday and be off Saturday and Sunday.		
Evidence of Implementation Method:	The SF status of SF-1 and SF-2 will be trended for 15 minute intervals for one week during the time period of August 24 to May 5 and one week from May 6 to August 23 to verify it is following the schedule specified in the Recommendation for Implementation section of the Findings Workbook. All space temperatures will be trended for one week as well during peak heating season and peak cooling season to assure spaces are warming up or cooling down to the desired setpoints before occupancy of the building.		

Annual Electric Savings (kWh):	201,643	Annual Natural Gas Savings (therms):	16,002
Estimated Annual kWh Savings ($):	$9,906	Estimated Annual Natural Gas Savings ($):	$11,890
Contractor Cost ($):	$168		
PBEEEP Provider Cost for Implementation Assistance ($):	$960		
Total Estimated Implementation Cost ($):	$1,128		

Estimated Annual Total Savings ($):	$21,796	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.05	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.05	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	261	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	25.7%	Percent of Implementation Costs:	1.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Armstrong Hall

FWB Number:	13301	Eco Number:	2
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Optimize Economizer	Date Identified:	3/9/2011
Description of Finding:	The current economizer enable/disable is set to 66 degF. Recommend setting to 71 degF for SF-1, SF-2 and SF-3 (ECO-2, ECO-7 and ECO-11)		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Screen Capture of current setpoint. Tested control sequece to verify that if OA is above setpoint, economizer dampers go to minimum position.		
Measure:	Modify the existing control economizer enable/disable sequence setpoint		
Recommendation for Implementation:	In the building automation system, modify the economizer enable/disable setpoint to 71 degF for SF-1, SF-2 and SF-3. Training will be given to staff so they are aware this value is now 71 F and if they change it due to operational issues, it needs to be documented and investigated why this value was changed.		
Evidence of Implementation Method:	Review control sequence BAS screen for verification that the modification of the ecomonizer enable/disable took place. Trend the damper position for each of the units during the outside air temperature of 71 degF to verify that the damper position transitioned between economizer and non-economizer.		

Annual Electric Savings (kWh):	5,823	Contractor Cost ($):	$84
Estimated Annual kWh Savings ($):	$440	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$1,044

Estimated Annual Total Savings ($):	$440	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.37	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.37	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	5	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.5%	Percent of Implementation Costs:	1.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Armstrong Hall

FWB Number:	13301	Eco Number:	4
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Supply Air Temperature Reset is not implemented or is sub-optimal	Date Identified:	3/21/2011
Description of Finding:	Currently the supply air temperature is at a constant 55 degF for SF-1 and SF-2. Recommend modification of control programming to allow the temperature to float between 55-65 degF.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Air Temperature Reset is not implemented or is sub-optimal		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	Review of current control sequence programming.		
Measure:	Modify the existing control programming of allow the supply air temperature to float between a minimum and maximum setpoint based on demand.		
Recommendation for Implementation:	Modify the existing control programming for SF-1 and SF-2 to allow the supply air temperature to float between a minimum (55 degF - adj) and maximum (65 degF - adj) setpoint based on cooling demand. Monitor the space temperatures being served by the AHU, once 20% (adj) of the space temperature require cooling, allow the supply air temperature setpoint to step from maximum to minimum. Once the space temperature cooling demand has dropped below 5% allow the supply air temperature setpoint to step from minimum to maximum. A DAT reset should be implemented for unit SF-3 as well, but with the unit serving two zones and one of them contains a reheat, the zone without the reheat may require a DAT higher then 65 F and the calculation did not factor this in so savings for it were not calculated, but the measure would save energy in SF-3 as well, just hard to quantify how much.		
Evidence of Implementation Method:	Review control sequence program modifications and perform functional testing. Trend the number of cooling demand requests (or space temperatures) for a minimum of two weeks to verify that all of the spaces for meeting the required setpoints.		

Annual Natural Gas Savings (therms):	3,146	Contractor Cost ($):	$2,106
Estimated Annual Natural Gas Savings ($):	$2,337	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$3,066

Estimated Annual Total Savings ($):	$2,337	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.31	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.31	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	17	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.8%	Percent of Implementation Costs:	3.9%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Armstrong Hall

FWB Number:	13301	Eco Number:	5
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	The steam control valve is leaking steam	Date Identified:	3/21/2011
Description of Finding:	The steam heating valve does not seat properly when commanded closed allowing some steam leak by and causing an increase in supply air temperature for SF-1 and SF-2(ECO-5 and ECO-10).		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Maintenance Related Problems
Finding Type:	Leaky/Stuck Valve		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	Review BAS mixed air and supply air temperatures taking screen captures with manual shutoff valve open and closed.		
Measure:	Repair control valve to allow have it seat properly.		
Recommendation for Implementation:	Repair steam valves for AHU SF-1 and SF-2 so that it will seat and not allow steam by when in fully closed position.		
Evidence of Implementation Method:	Trend the steam valve position, mixed air temperature and supply air temperature or datalog the temperature of the supply steam piping for a minimum of two weeks to verify that when the steam valve is in the closed position, no steam is migrating into the heating coil.		

Annual Electric Savings (kWh):	8,836	Annual Natural Gas Savings (therms):	489
Estimated Annual kWh Savings ($):	$700	Estimated Annual Natural Gas Savings ($):	$363
Contractor Cost ($):	$2,106		
PBEEEP Provider Cost for Implementation Assistance ($):	$960		
Total Estimated Implementation Cost ($):	$3,066		

Estimated Annual Total Savings ($):	$1,063	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.88	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.88	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	10	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.3%	Percent of Implementation Costs:	3.9%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Armstrong Hall

FWB Number:	13301	Eco Number:	7
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Equipment is enabled regardless of need, or such enabling is excessive.	Date Identified:	3/22/2011
Description of Finding:	The Series Fan Powered VAV boxes are occupied 24/7/365. Therefore the fan motor is running during those time. ECO-15		
Equipment or System(s):	VAV terminal unit	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Implement by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	Reviewed control programming of VAV boxes.		
Measure:	Modify the control programming to allow scheduling of the VAV box fan to go unoccupied as per Owner's schedule		
Recommendation for Implementation:	Modify the control programming for all Fan Powered VAV boxes' fan speed to allow occupied/unoccupied control by reducing the fan speed to zero during unoccupied conditions. The VAV boxes will have to engage during unoccupied times if the space temperatue falls below space temperture setpoint.		
Evidence of Implementation Method:	Review programming of VAV boxes and perform functional testing. Trend the VAV box fan speed for a minimum of two weeks to verify that when the VAV box is in unoccupied mode the fan speed drops to zero.		

Annual Electric Savings (kWh):	63,270	Contractor Cost ($):	$1,008
Estimated Annual kWh Savings ($):	$2,844	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$1,968

Estimated Annual Total Savings ($):	$2,844	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.69	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.69	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	54	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.4%	Percent of Implementation Costs:	2.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Building: Centennial Student Union

Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU Run Time Reduction	$1,128	$7,219	0.16	$0	0.16	70
3	Reheat Pumps Runtime Reduction	$2,976	$341	8.74	$0	8.74	4
	Total for Findings with Payback 3 years or less:	**$1,128**	**$7,219**	**0.16**	**$0**	**0.16**	**70**
	Total for all Findings:	**$4,104**	**$7,560**	**0.54**	**$0**	**0.54**	**74**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Centennial Student Union

FWB Number:	13302	Eco Number:	1
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	AHU Run Time Reduction	Date Identified:	8/18/2011
Description of Finding:	The AHU's runtime was compared to the scheduling completed through the schedule posted scheduled on the University's website. Once compared, the following ECOs were calculated and combined into the measure: ECO-1 for SF-23; ECO-3 for SF-27.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By reviewing the BAS Schedule currently installed and by reviewing the trending of the status of the supply fan. Then comparing this to the schedule posted on the University's website		
Measure:	Modification of the existing equipment schedule residing in the BAS.		
Recommendation for Implementation:	A schedule will be initiated on all AHUs to shut down the units when there is no occupancy in the building. There will be two schedules. During regular school session the units will run as per the earliest scheduled posted on the University's website. The AHU schedule will change each semester and the owner should update the schedules accordenly. The new current schedule was set to the following: SF-23: From September 1st to May 31st: Monday through Thursday 7 AM to 7 PM, Friday 7 AM to 4 PM and Satureday f11 AM to 3 PM. The unit will be off on sunday SF-23: From June 1st to August 31st, Monday through Friday 8 AM to 4 PM Off Satureday and Sunday SF-27 Year Around, Monday thorugh Friday 6 AM to Midnight, Saturday 8 AM to midnight and Sunday 10 AM to midnight.		
Evidence of Implementation Method:	The SF status of all AHUs will be trended for 15 minute intervals for one week during the time period of regular school session and one week for the summer school session to verify it is following the schedule specified in the Recommendation for Implementation section of the Findings Workbook. All space temperatures will be trended for one week as well during peak heating season and peak cooling season to assure spaces are warming up or cooling down to the desired setpoints before occupancy of the building.		

Annual Electric Savings (kWh):	33,490	Annual Natural Gas Savings (therms):	7,488
Estimated Annual kWh Savings ($):	$1,656	Estimated Annual Natural Gas Savings ($):	$5,563
Contractor Cost ($):	$168		
PBEEEP Provider Cost for Implementation Assistance ($):	$960		
Total Estimated Implementation Cost ($):	$1,128		

Estimated Annual Total Savings ($):	$7,219	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.16	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.16	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	70	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	8.5%	Percent of Implementation Costs:	1.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Centennial Student Union

FWB Number:	13302	Eco Number:	3
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Reheat Pumps Runtime Reduction	Date Identified:	8/18/2011
Description of Finding:	Currently the Reheat Pump, HW Pump P-1, HW Pump P-2 are running based on outside air temperature of less than 99 degF. ECO-4, ECO-5 and ECO-6 respectively.		
Equipment or System(s):	Pump, HW distribution	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the pump statuses for Reheat Pump, HW Pump P-1 and HW Pump P-2.		
Measure:	Modifiy the existing control sequence programming to allow the pumps to run whenever the outside air temperature is less than 75 degF.		
Recommendation for Implementation:	Modifiy the existing control sequence programming to allow the pumps to run whenever the outside air temperature is less than 75 degF and any combination of reheat valve control is greater than 10% (adj). If the outside air temperature is greater than 75 degF (adj), monitor the reheat valve position and if 20% (adj) of the reheat valves are opening, allow the pumps to start. Disable the pumps when the valve positions are less that 5% (adj).		
Evidence of Implementation Method:	Review the control sequence program modifications and perform functional testing. Trend the reheat valve positions and space temperatures for two weeks when the outside air temperature is great than 75 degF to verify that the spaces are getting adequate reheat.		

Annual Electric Savings (kWh):	4,961	Contractor Cost ($):	$2,016
Estimated Annual kWh Savings ($):	$341	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$2,976

Estimated Annual Total Savings ($):	$341	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	8.74	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	8.74	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	4	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.4%	Percent of Implementation Costs:	3.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Building: Ford Hall
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Exhaust Fan Volume Reduction	$43,988	$7,245	6.07	$0	6.07	109
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$43,988**	**$7,245**	**6.07**	**$0**	**6.07**	**109**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Ford Hall

FWB Number:	13303	Eco Number:	1
Site:	MSU Mankato	Date/Time Created:	5/9/2012

Investigation Finding:	Exhaust Fan Volume Reduction	Date Identified:	12/20/2011
Description of Finding:	Laboratory exhaust fans EF-30A&B,31A&B,32A&B,33A&B currently operate as a constant volume system. The exhaust in the laboratorys is variable however the exhaust fans run at a constant speed. When the laboratory exhaust is not flowing 100%, and outside air damper supplies the remaining air to the fan. The fans run year round.		
Equipment or System(s):	Other	Finding Category:	Equipment Efficiency Improvements / Load Reduction
Finding Type:	Other Equipment Efficiency/Load Reduction		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Functional Testing, Equipment Inspection and Trending of Usage		
Measure:	This ECO proposes to ramp the exhaust fans based on laboratory demand and leave the outside air damper in the closed position.		
Recommendation for Implementation:	For EF-30A, EF-30B, EF-31A, EF-31B, EF-32A, EF-32B, EF-33A and EF-33B. These exhaust fans will have the OA damper associated with Exhaust fans on AHU-30, 31, 32, and 33 closed off. If the exhaust fans don't already have VFDs on them, an VFD will have to be installed on the fans. The cost for that is included in the Contractor Cost for this measure. If the units do have VFDs, the cost will decrease. The exhaust fans will modulate their speed based off the duct static pressure setpoints. This setpoint will be set by a balancer. The setpoint will be when the fan is at 100% and all spaces require 100% exhaust flow. Units 31 and 33 don't have duct static pressure readings on them at this time, if they require these points to be mapped and setup they will have to be. This cost was also factored into the contractor cost, if it is not needed the cost will decrease to implement this measure. There are two areas of concern which need to be addressed before this measure is implemented. One is if the OA dampers are used in any way to assure space pressure. If they are, this measure needs to be re-visited before it is implemented. The other area is associated with the throw of the exhaust fan. If the exhaust requires a certain throw from the diffuser it will be decreased if the speed of the fan is reduced. Throw requirements of the exhaust air need to be investigated before this measure can be implemented.		
Evidence of Implementation Method:	Function testing, equipment inspection and trending of the EFs VFD Speed, Exhaust Duct Static Pressure, Exhaust Duct Static Pressure Setpoint, Exhaust Fans Outside Air Damper Position at an interval of 15 minutes for a period of two weeks during the normal school session and summer school sessions.		

Annual Electric Savings (kWh):	127,368	Contractor Cost ($):	$43,068
Estimated Annual kWh Savings ($):	$7,245	PBEEEP Provider Cost for Implementation Assistance ($):	$920
		Total Estimated Implementation Cost ($):	$43,988

Estimated Annual Total Savings ($):	$7,245	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	6.07	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	6.07	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	109	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	8.6%	Percent of Implementation Costs:	55.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Building: Memorial Library
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU Runtime Reduction	$1,044	$22,026	0.05	$0	0.05	246
3	AHU Supply Air Temperature Reset	$2,976	$1,672	1.78	$0	1.78	12
2	AHU Optimize Economizer	$1,044	$519	2.01	$0	2.01	7
4	Reheat Pump Runtime Reduction	$2,976	$560	5.31	$0	5.31	8
	Total for Findings with Payback 3 years or less:	**$5,064**	**$24,218**	**0.21**	**$0**	**0.21**	**266**
	Total for all Findings:	**$8,040**	**$24,778**	**0.32**	**$0**	**0.32**	**274**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Memorial Library

FWB Number:	13304	Eco Number:	1
Site:	MSU Mankato	Date/Time Created:	5/9/2012

Investigation Finding:	AHU Runtime Reduction	Date Identified:	6/20/2011
Description of Finding:	The AHU is currently running 24/7/365. Upon review of the Library Schedule posted on their website (PDF copy of the schedule is within the attached documents) the annual run time can be reduced. Each AHU has a different ECO as listed: SF-1 = ECO-1; SF-2 = ECO-4; SF-3 = ECO-7; SF-36 = ECO-10		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Review trending of the supply fan status for each of the AHUs and compared it to the published Library Hours Schedule.		
Measure:	Modification of the existing equipment schedule residing in the BAS.		
Recommendation for Implementation:	A schedule will be initiated on SF-1, SF-2, SF-3 and SF-36 to shut down the units when there is no occupancy in the building. There will be two schedules. During regular school and during the summer session. The AHUs will follow the schedule below for the regular school year: SF-1, SF-2, SF-3 and SF-36: 7 AM to 2 AM Monday through Thursday, 7 AM to 7 PM Friday, 10 AM to 6 PM Saturday, 1 PM to midnight on Sunday. The AHU will follow the schedule below for the summer session will follow the schedule below: SF-1, SF-2, SF-3 and SF-36: 7 AM to 7 PM Monday through Thursday, 7 AM to 5 PM Friday, 10 AM to 5 PM Saturday, and 1 PM to 9 PM Sunday		
Evidence of Implementation Method:	The SF status of all AHUs will be trended for 15 minute intervals for one week during the time period of regular school session and one week for the summer school session to verify it is following the schedule specified in the Recommendation for Implementation section of the Findings Workbook. All space temperatures will be trended for one week as well during peak heating season and peak cooling season to assure spaces are warming up or cooling down to the desired setpoints before occupancy of the building.		

Annual Electric Savings (kWh):	152,414	Annual Natural Gas Savings (therms):	20,879
Estimated Annual kWh Savings ($):	$6,513	Estimated Annual Natural Gas Savings ($):	$15,513
Contractor Cost ($):	$84		
PBEEEP Provider Cost for Implementation Assistance ($):	$960		
Total Estimated Implementation Cost ($):	$1,044		

Estimated Annual Total Savings ($):	$22,026	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.05	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.05	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	246	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	26.0%	Percent of Implementation Costs:	1.3%

Findings Details

Building: Memorial Library

FWB Number:	13304	Eco Number:	2
Site:	MSU Mankato	Date/Time Created:	5/9/2012

Investigation Finding:	AHU Optimize Economizer	Date Identified:	6/20/2011
Description of Finding:	Recommend modification of the economizer enable/disable setpoint from 66 degF to 71 degF. This modification is based on ASHRAE local climate zone. Each AHU has a different ECO as listed: SF-1 = ECO-2; SF-2 = ECO-5; SF-3 = ECO-8; SF-36 = ECO-11		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the AHUs mixed air damper position verses the outside air temperature and the BAS software.		
Measure:	Modification of the existing BAS economizer enable/disable setpoint.		
Recommendation for Implementation:	Modify the economizer enable/disable setpoint for SF-1, SF-2, SF-3 and SF-36 from the existing value of 68 degF to the recommended value of 71 degF		
Evidence of Implementation Method:	Review control sequence BAS screen for verification that the modification of the economizer enable/disable took place. Trend the damper position for each of the units during the outside air temperature of 71 degF to verify that the damper position transitioned between economizer and non-economizer.		

Annual Electric Savings (kWh):	8,003	Contractor Cost ($):	$84
Estimated Annual kWh Savings ($):	$519	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$1,044

Estimated Annual Total Savings ($):	$519	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.01	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.01	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	7	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.6%	Percent of Implementation Costs:	1.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Memorial Library

FWB Number:	13304	Eco Number:	3
Site:	MSU Mankato	Date/Time Created:	5/9/2012

Investigation Finding:	AHU Supply Air Temperature Reset	Date Identified:	6/20/2011
Description of Finding:	Recommend implementation of programming to provided AHU Supply Air Reset based on the space temperature demands for heating and cooling. Each AHU has a different ECO as listed: SF-1 = ECO-3; SF-2 = ECO-6		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Air Temperature Reset is not implemented or is sub-optimal		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the AHUs discharge air temperature and discharge air temperature setpoint.		
Measure:	Modify the existing control programming of allow the supply air temperature to float between a minimum and maximum setpoint based on demand.		
Recommendation for Implementation:	Modify the existing control programming for SF-1 and SF-2 to allow the supply air temperature to float between a minimum (55 degF - adj) and maximum (65 degF - adj) setpoint based on cooling demand. Monitor the space temperatures being served by the AHU, once 20% (adj) of the space temperature require cooling, allow the supply air temperature setpoint to step from maximum to minimum. Once the space temperature cooling demand has dropped below 5% allow the supply air temperature setpoint to step from minimum to maximum.		
Evidence of Implementation Method:	Review control sequence program modifications and perform functional testing. Trend the number of cooling demand requests (or space temperatures) for a minimum of two weeks to verify that all of the spaces for meeting the required setpoints. Trend the MAT, DAT, RAT, OAT, SF speed, SF status, DAT setpoint, and OA damper to assure the unit is operating properly to maintain the DAT setpoint.		

Annual Natural Gas Savings (therms):	2,251	Contractor Cost ($):	$2,016
Estimated Annual Natural Gas Savings ($):	$1,672	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$2,976

Estimated Annual Total Savings ($):	$1,672	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.78	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.78	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	12	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.0%	Percent of Implementation Costs:	3.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Memorial Library

FWB Number:	13304	Eco Number:	4
Site:	MSU Mankato	Date/Time Created:	5/9/2012

Investigation Finding:	Reheat Pump Runtime Reduction	Date Identified:	6/20/2011
Description of Finding:	Currently the Reheat Pumps for the new converter (P-1 & P-2) and the original building converter (P-5 & P-6) are running based on outside air temperature of less than 99 degF. ECO-13		
Equipment or System(s):	Pump, HW distribution	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the pump statuses for P-1, P-2 and P-5, P-6.		
Measure:	Modify the existing control sequence programming to allow the pumps to run whenever the outside air temperature is less than 50 degF.		
Recommendation for Implementation:	Modify the existing control sequence programming to allow the pumps to run whenever the outside air temperature is less than 50 degF and any combination of reheat valve control is greater than 10% (adj). If the outside air temperature is greater than 50 degF (adj), monitor the reheat valve position and if 15% (adj) of the reheat valves are opening, allow the pumps to start. Disable the pumps when the valve positions are less that 5% (adj).		
Evidence of Implementation Method:	Review the control sequence program modifications and perform functional testing. Trend the reheat valve positions and space temperatures for two weeks when the outside air temperature is great than 50 degF to verify that the spaces are getting adequate reheat. Trend P-1, P-2, P-5, and P-6 pump status as well to assure they are disengaging and engaging when they should be.		

Annual Electric Savings (kWh):	9,486	Contractor Cost ($):	$2,016
Estimated Annual kWh Savings ($):	$560	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$2,976

Estimated Annual Total Savings ($):	$560	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	5.31	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	5.31	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	8	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.7%	Percent of Implementation Costs:	3.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Building: Morris Hall
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	SF-1 Runtime Reduction	$1,004	$551	1.82	$0	1.82	5
2	SF-1 Optimizer Economizer	$1,004	$50	19.95	$0	19.95	1
	Total for Findings with Payback 3 years or less:	**$1,004**	**$551**	**1.82**	**$0**	**1.82**	**5**
	Total for all Findings:	**$2,008**	**$602**	**3.34**	**$0**	**3.34**	**6**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Morris Hall

FWB Number:	13305	Eco Number:	1
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	SF-1 Runtime Reduction	Date Identified:	6/2/2011
Description of Finding:	The runtime reduction of the fan serving classroom spaces. Based on the classroom schedule on the schools webpage: http://r25web.mnsu.edu, the typical schedule is 8:00am to 10:00pm Mon-Fri.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By reviewing the trending of the SF-1 Status and the BAS Schedule, the AHU is started earlier than the actual schedule is needed for that area of the building.		
Measure:	Modification of the existing BAS schedule.		
Recommendation for Implementation:	A schedule will be initiated on SF-1 to shut down the units when there is no occupancy in the building. There will be two schedules. During regular school session from August 24 to May 5 the units will run from 8 AM to 10 PM Monday through Thursday, 8 AM to 5 PM on Friday, and off on Saturday and Sunday. During summer session from May 6 to August 23 the units will run from 8 AM to 4 PM Monday through Friday and be off Saturday and Sunday.		
Evidence of Implementation Method:	The SF status of SF-1 will be trended for 15 minute intervals for one week during the time period of August 24 to May 5 and one week from May 6 to August 23 to verify it is following the schedule specified in the Recommendation for Implementation section of the Findings Workbook. All space temperatures will be trended for one week as well during peak heating season and peak cooling season to assure spaces are warming up or cooling down to the desired setpoints before occupancy of the building.		

Annual Electric Savings (kWh):	1,937	Annual Natural Gas Savings (therms):	636
Estimated Annual kWh Savings ($):	$79	Estimated Annual Natural Gas Savings ($):	$472
Contractor Cost ($):	$84		
PBEEEP Provider Cost for Implementation Assistance ($):	$920		
Total Estimated Implementation Cost ($):	$1,004		

Estimated Annual Total Savings ($):	$551	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.82	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.82	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	5	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.7%	Percent of Implementation Costs:	1.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Morris Hall

FWB Number:	13305	Eco Number:	2
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	SF-1 Optimizer Economizer	Date Identified:	6/2/2011
Description of Finding:	Recommend modification of the economizer enable/disable setpoint from 66 degF to 71 degF. This modification is based on ASHRAE local climate zone.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By reviewing the trending of SF-1 mixed air damper position verses the outside air temperature and the BAS software.		
Measure:	Modification of the existing BAS economizer enable/disable setpoint.		
Recommendation for Implementation:	Modify the economzier enable/disable setpoint from the existing value of 66 degF to the recommended value of 71 degF. Training will be given to staff so they are aware this value is now 71 F and if they change it due to operational issues, it needs to be documented and investigated why this value was changed.		
Evidence of Implementation Method:	Review control sequence BAS screen for verification that the modification of the ecomonizer enable/disable took place. Trend the damper position for a two week period each of the units during the outside air temperature range of 60 to 75 degF to verify that the damper position transitioned between economizer and non-economizer.		

Annual Electric Savings (kWh):	628	Contractor Cost ($):	$84
Estimated Annual kWh Savings ($):	$50	PBEEEP Provider Cost for Implementation Assistance ($):	$920
		Total Estimated Implementation Cost ($):	$1,004

Estimated Annual Total Savings ($):	$50	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	19.95	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	19.95	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.1%	Percent of Implementation Costs:	1.3%

Findings Summary

Building: Nelson w/addition
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU/RTU Runtime Reduction	$1,004	$3,594	0.28	$0	0.28	42
5	Reheat Pump Runtime Reduction	$1,004	$548	1.83	$0	1.83	8
	Total for Findings with Payback 3 years or less:	**$2,008**	**$4,142**	**0.48**	**$0**	**0.48**	**50**
	Total for all Findings:	**$2,008**	**$4,142**	**0.48**	**$0**	**0.48**	**50**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: Nelson w/addition

FWB Number:	13306	Eco Number:	1
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	AHU/RTU Runtime Reduction	Date Identified:	7/20/2011
Description of Finding:	The AHU's and RTU's runtime was compared to the scheduling completed through the schedule posted for room reservations located at http://r25web.mnsu.edu website. Once compared, the following ECOs were calculated and combined into the measure: ECO-1 for SF-1 ECO-5 for RTU2 ECO-7 for SF-5 ECO-9 for SF-6 ECO-11 for SF-7 ECO-13 for SF-8 ECO-15 for RU-1 ECO-17 for RU-2 ECO-19 for RU-3		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By reviewing the BAS Schedule currently installed and by reviewing the trending of the status of the supply fan. Then comparing this to the schedule posted for room reservations located at http://r25web.mnsu.edu.		
Measure:	Modification of the existing equipment schedule residing in the BAS.		
Recommendation for Implementation:	A schedule will be initiated on all AHUs and RTUs to shut down the units when there is no occupancy in the building. There will be two schedules. During regular school session the units will run as per the earliest scheduled classroom or 8AM whichever is earliest for staff and students. Currently the new proposed regurlar school session schedule for unit would be: SF-1: 8 AM-9PM Monday through Thursday, 8 AM to 3 PM Friday and off Saturday and Sunday RTU-2: 8 AM to 10 PM Monday through Thursday, 8 AM to 5 PM Friday and off Saturday and Sunday SF-5: 8 AM to 8 PM Monday through Thursday, 8 AM to 5 PM Friday and off Saturday and Sunday SF-6: 8 AM to 10 PM Monday through Thursday, 8 AM to 5 PM Friday and off Saturday and Sunday SF-7: 8 AM to 6 PM Monday through Thursday, 8 AM to 5 PM Friday and off Saturday and Sunday SF-8: 8 AM to 9 PM Monday through Thursday, 8 AM to 5 PM Friday and off Saturday and Sunday RU-1: 8 AM to 10Pm Monday through Thursday, 8 AM to 6 PM Friday and off Saturday and Sunday RU-2: 8 AM to 5 PM Monday through Friday, off Saturday and Sunday RU-3: 8 AM to 9 PM Monday through Thursday, 8 AM to 6 PM Friday and off Saturday and Sunday The summer schedule for each unit currently would be as follows: SF-1: 8 AM to 3 PM Monday through Thursday, 8 AM to noon on Friday, and off Saturday and Sunday RTU-2: 8 AM to 4 PM Monday through Friday and off Saturday and Sunday SF-5: 8 AM to 4 PM Monday through Friday and off Saturday and Sunday SF-6: Monday through Friday 8 AM to 3 PM off Saturday and Sunday SF-7: 8 AM to 4 PM Monday to Friday and off Saturday and Sunday SF-8: Off RU-1: 8 AM to 4 PM Monday through Friday and off Saturday and Sunday RU-2: 8 AM to 4 PM Monday through Friday and off Saturday and Sunday RU-3: 8 AM to 4 PM Monday through Friday and off Saturday and Sunday		
Evidence of Implementation Method:	The SF status of all AHUs will be trended for 15 minute intervals for one week during the time period of regular school session and one week for the summer school session to verify it is following the schedule specified in the Recommendation for Implementation section of the Findings Workbook. All space temperatures will be trended for one week as well during peak heating season and peak cooling season to assure spaces are warming up or cooling down to the desired setpoints before occupancy of the building.		

Annual Electric Savings (kWh):	29,381	Annual Natural Gas Savings (therms):	3,082
Estimated Annual kWh Savings ($):	$1,304	Estimated Annual Natural Gas Savings ($):	$2,290
Contractor Cost ($):	$84		
PBEEEP Provider Cost for Implementation Assistance ($):	$920		
Total Estimated Implementation Cost ($):	$1,004		

Estimated Annual Total Savings ($):	$3,594	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.28	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.28	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	42	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	4.2%	Percent of Implementation Costs:	1.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Nelson w/addition

FWB Number:	13306	Eco Number:	5
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Reheat Pump Runtime Reduction	Date Identified:	7/20/2011
Description of Finding:	Currently the Reheat Pumps for the HW Pumps (P-1 & P-2) and the Auto HW Pumps (P-1 & P-2) and the Radiation Pump are running based on outside air temperature of less than 99 degF. ECO-20, ECO-21 and ECO-22		
Equipment or System(s):	Pump, HW distribution	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the pump statuses for HW P-1, P-2; Auto P-1 and P-2 and Radiation Pump.		
Measure:	Modifiy the existing control sequence programming to allow the pumps to run whenever the outside air temperature is less than 55 degF.		
Recommendation for Implementation:	Modifiy the existing control sequence programming to allow the pumps to run whenever the outside air temperature is less than 55 degF and any combination of reheat valve control is greater than 10% (adj). If the outside air temperature is greater than 55 degF (adj), monitor the reheat valve position and if 15% (adj) of the reheat valves are opening, allow the pumps to start. Disable the pumps when the valve positions are less that 5% (adj).		
Evidence of Implementation Method:	Review the control sequence program modifications and perform functional testing. Trend the reheat valve positions and space temperatures for two weeks when the outside air temperature is great than 55 degF to verify that the spaces are getting adequate reheat. The status of Reheat pump 1 and 2, Auto HW 1 and 2 and the Radiation pump will be trended during this same period to assure they are turning off.		

Annual Electric Savings (kWh):	9,293	Contractor Cost ($):	$84
Estimated Annual kWh Savings ($):	$548	PBEEEP Provider Cost for Implementation Assistance ($):	$920
		Total Estimated Implementation Cost ($):	$1,004

Estimated Annual Total Savings ($):	$548	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.83	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.83	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	8	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.6%	Percent of Implementation Costs:	1.3%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

PBEEEP State Government

Building: Utility Plant
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Chillers are staged based on percentage of load in lieu of actual demand.	$2,304	$6,498	0.35	$0	0.35	103
13	Chiller Condenser Water Pump CP-3C	$2,592	$2,630	0.99	$0	0.99	42
	Total for Findings with Payback 3 years or less:	**$4,896**	**$9,128**	**0.54**	**$0**	**0.54**	**145**
	Total for all Findings:	**$4,896**	**$9,128**	**0.54**	**$0**	**0.54**	**145**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Utility Plant

FWB Number:	13307	Eco Number:	1
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Chillers are staged based on percentage of load in lieu of actual demand.	Date Identified:	6/2/2011
Description of Finding:	The chillers are staged based on percent of capacity rather than needed flow or supply chilled water to campus. Investigating the possibility of stagging utilizing the campus demand.		
Equipment or System(s):	Chiller Plant	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Functional Testing; Trending of Chilled Water system points. Utilitzing the "Point Trending" page of the spreadsheet, all points are trended based on the outside air temperature reference. The average load of the campus and average Kw of the chiller load where determined in columns AK and AL, plotted and used for the baseline load and Kw in the TMY "Calculations" page.		
Measure:	ECO-1: Measure-1, 2 and 3 are consolidated into one calculation represented in ECO-1. Base the chiller(s) combination on the calculated campus load profile at any given time period.		
Recommendation for Implementation:	Monitor the Campus load and enable each of the chillers based on the campus load profile. Once the first chiller is enabled, monitor the load and enable the next chiller when 90% capacity of the combination of chiller(s) currently enabled. Unload each combination when the campus load is less than 20% capacity of the combination of chiller(s) currently enabled.		
Evidence of Implementation Method:	Trend each point in the chilled water system for a period of one month during the time when the outside air temperature is consistantly above 60 degF or June or July. The trend interval should be 15 minutes. All points on the chilled water system will be trended during this time (chiilers, pumps, and cooling tower)		

Annual Electric Savings (kWh):	120,329	Contractor Cost ($):	$1,344
Estimated Annual kWh Savings ($):	$6,498	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$2,304

Estimated Annual Total Savings ($):	$6,498	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.35	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.35	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	103	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	7.7%	Percent of Implementation Costs:	2.9%

Findings Details

Building: Utility Plant

FWB Number:	13307	Eco Number:	13
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Chiller Condenser Water Pump CP-3C	Date Identified:	6/2/2011
Description of Finding:	ECO-2: This pump's speed is VFD controlled. The pump is rated on 4920 gpm but with no combination of chillers needing condenser water at 4920 gpm (each chiller condenser water gpm is 3000 gpm or 3300 gpm), the cooling tower system is being overpumped. Recommend installation of control device to regulate the flow needed for the particular chiller that is being operated or calibrate the existing flow meters and utilize the flow meters for condenser flow through each chiller.		
Equipment or System(s):	Condenser Water Pump	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Pump Speed Doesn't Vary Sufficiently		

Implementer:	Controls Contractor
Benefits:	Energy Savings
Baseline Documentation Method:	Review the trending of the pump VFD speed to determine speed needed for the chiller that is being operated. Two chillers need 3000 gpm and one chiller needs 3300 gpm.
Measure:	ECO-2: This pump's speed is VFD controlled. The pump is rated on 4920 gpm but with no combination of chillers needing condenser water at 4920 gpm (each chiller condenser water gpm is 3000 gpm or 3300 gpm), the cooling tower system is being overpumped. Recommend installation of control device to regulate the flow needed for the particular chiller that is being operated or calibrate the existing flow meters and utilize the flow meters for condenser flow through each chiller.
Recommendation for Implementation:	The balancer will first measure the flow of CP-3C with how the system is setup, if the balancer finds the power of the pump and the gpm of the pump to be 125 HP and 4,920 gpm, the water pump can be rebalaced to maintain a differential pressure setpoint requirement based off 3,300 gpm. Set the CP-3C VFD analog output to the needed flow rate based on the chiller enabled. Verify the flow rate by using the pressure drop needed with each associated chiller.
Evidence of Implementation Method:	Functional testing and trend the CP-3C VFD analog output at a internal of 15 minutes for a period of two weeks during times when chiller-1 is enabled. The chiller condenser water supply and return temperatures will be trended to assure they are meeting the requirements with the reduced condenser water flow.

Annual Electric Savings (kWh):	48,702	Contractor Cost ($):	$1,632
Estimated Annual kWh Savings ($):	$2,630	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$2,592

Estimated Annual Total Savings ($):	$2,630	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.99	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.99	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	42	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.1%	Percent of Implementation Costs:	3.3%

Findings Summary

Building: Wiecking Center
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU Run Time Reduction	$1,128	$2,513	0.45	$0	0.45	25
3	AHU Supply Air Temperature Reset	$2,976	$211	14.11	$0	14.11	2
	Total for Findings with Payback 3 years or less:	**$1,128**	**$2,513**	**0.45**	**$0**	**0.45**	**25**
	Total for all Findings:	**$4,104**	**$2,724**	**1.51**	**$0**	**1.51**	**27**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Wiecking Center

FWB Number:	13308	Eco Number:	1
Site:	MSU Mankato	Date/Time Created:	5/23/2012

Investigation Finding:	AHU Run Time Reduction	Date Identified:	12/15/2011
Description of Finding:	The AHU's runtime was compared to the scheduling completed through the schedule posted scheduled on the University's website. Once compared, the following ECOs were calculated and combined into the measure: ECO-2 for SF-2 ECO-4 for SF-5 ECO-7 for SF-9		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By reviewing the BAS Schedule currently installed and by reviewing the trending of the status of the supply fan. Then comparing this to the schedule posted on the University's website		
Measure:	Modification of the existing equipment schedule residing in the BAS.		
Recommendation for Implementation:	A schedule will be initiated on all AHUs to shut down the units when there is no occupancy in the building. This building is utilize by campus facilities personnel and in most cases, the occupancy will be a normal business day (M-F). SF-2: 7 AM to 9 PM Monday, Tuesday, Wedensday. 7 AM to 4 PM Thursday. 7 AM to 1 PM Friday. Off Saturday and Sunday. SF-5: 6 AM to 6 PM Monday through Friday and be off Saturday and Sunday. SF-9: 6 AM to 5 PM Monday, Thursday, Friday, 6 AM to 7 PM Tuesday and Wednesday and off Saturday and Sunday.		
Evidence of Implementation Method:	The SF status of all AHUs will be trended for 15 minute intervals for one week during the time period of regular school session and one week for the summer school session to verify it is following the schedule specified in the Recommendation for Implementation section of the Findings Workbook. All space temperatures will be trended for one week as well during peak heating season and peak cooling season to assure spaces are warming up or cooling down to the desired setpoints before occupancy of the building.		

Annual Electric Savings (kWh):	13,050	Annual Natural Gas Savings (therms):	2,558
Estimated Annual kWh Savings ($):	$613	Estimated Annual Natural Gas Savings ($):	$1,900
Contractor Cost ($):	$168		
PBEEEP Provider Cost for Implementation Assistance ($):	$960		
Total Estimated Implementation Cost ($):	$1,128		

Estimated Annual Total Savings ($):	$2,513	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.45	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.45	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	25	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.0%	Percent of Implementation Costs:	1.4%

Findings Details

Building: Wiecking Center

FWB Number:	13308	Eco Number:	3
Site:	MSU Mankato	Date/Time Created:	5/23/2012

Investigation Finding:	AHU Supply Air Temperature Reset	Date Identified:	12/15/2011
Description of Finding:	Recommend implementation of programming to provided AHU Supply Air Reset based on the space temperature demands for heating and cooling. ECO as listed: ECO-6 for SF-5		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Air Temperature Reset is not implemented or is sub-optimal		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the AHUs discharge air temperature and discharge air temperature setpoint.		
Measure:	Modify the existing control programming of allow the supply air temperature to float between a minimum and maximum setpoint based on demand.		
Recommendation for Implementation:	Modify the existing control programming for SF-5 to allow the supply air temperature to float between a minimum (55 degF - adj) and maximum (65 degF - adj) setpoint based on cooling demand. Monitor the space temperatures being served by the AHU, once 20% (adj) of the space temperature require cooling, allow the supply air temperature setpoint to step from maximum to minimum. Once the space temperature cooling demand has dropped below 5% allow the supply air temperature setpoint to step from minimum to maximum.		
Evidence of Implementation Method:	Review control sequence program modifications and perform functional testing. Trend the number of cooling demand requests (or space temperatures) for a minimum of two weeks to verify that all of the spaces for meeting the required setpoints. Trend the MAT, DAT, OAT, RAT, HW valve, CHW Valve, OA damper, SF status, and SF speed of the AHU unit to assure it is functioning properly and meeting the appropriate DAT to meet space demands.		

Annual Natural Gas Savings (therms):	284	Contractor Cost ($):	$2,016
Estimated Annual Natural Gas Savings ($):	$211	PBEEEP Provider Cost for Implementation Assistance ($):	$960
		Total Estimated Implementation Cost ($):	$2,976

Estimated Annual Total Savings ($):	$211	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	14.11	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	14.11	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	2	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.2%	Percent of Implementation Costs:	3.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13301 - MSU Mankato-Armstrong Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	AHU/VAV Fan		See ECO documentation for results
	a.3 (3)	Lighting is on more hours than necessary.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	AHU		See ECO documentation for results
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	b.3 (7)	OTHER_Economizer/OA Loads	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.4 (11)	OTHER_Controls	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	X	AHU		See ECO documentation for results
	d.6 (17)	Other_Controls (Setpoint Changes)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	X	AHU		See ECO documentation for results
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	X	AHU		See ECO documentation for results
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.6 (22)	Other_Controls (Reset Schedules)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.2 (24)	Pump Discharge Throttled	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.3 (25)	Over-Pumping	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.4 (26)	Equipment is oversized for load.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.1 (28)	VFD Retrofit - Fans	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13301 - MSU Mankato-Armstrong Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.3 (30)	VFD Retrofit - Motors (process)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.4 (31)	OTHER_VFD	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
h. Retrofits:	h.1 (32)	Retrofit - Motors	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.2 (33)	Retrofit - Chillers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.4 (35)	Retrofit - Boilers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.5 (36)	Retrofit - Packaged Gas fired heating	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.6 (37)	Retrofit - Heat Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.7 (38)	Retrofit - Equipment (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.8 (39)	Retrofit - Pumping distribution method	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.9 (40)	Retrofit - Energy/Heat Recovery	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.10 (41)	Retrofit - System (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.11 (42)	Retrofit - Efficient Lighting	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.12 (43)	Retrofit - Building Envelope	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.13 (44)	Retrofit - Alternative Energy	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.14 (45)	OTHER_Retrofit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.2 (47)	Impurity/Contamination	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.3 ( )	Leaky/Stuck Damper	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.4 ( )	Leaky/Stuck Valve	X	AHU		See ECO documentation for results
	i.5 (48)	OTHER_Maintenance	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
j. OTHER	j.1 (49)	OTHER	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13302 - MSU Mankato-Centennial Student Union

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive				
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive				
	a.3 (3)	Lighting is on more hours than necessary.				
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)				
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.				
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive				
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement				
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints				
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.				
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.				
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently				
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently				
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary				
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal				
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal				
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal				
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal				
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit				
	f.2 (24)	Pump Discharge Throttled				
	f.3 (25)	Over-Pumping				
	f.4 (26)	Equipment is oversized for load.				
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans				

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13302 - MSU Mankato-Centennial Student Union

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps				
	g.3 (30)	VFD Retrofit - Motors (process)				
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				
	h.2 (33)	Retrofit - Chillers				
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)				
	h.4 (35)	Retrofit - Boilers				
	h.5 (36)	Retrofit - Packaged Gas fired heating				
	h.6 (37)	Retrofit - Heat Pumps				
	h.7 (38)	Retrofit - Equipment (custom)				
	h.8 (39)	Retrofit - Pumping distribution method				
	h.9 (40)	Retrofit - Energy/Heat Recovery				
	h.10 (41)	Retrofit - System (custom)				
	h.11 (42)	Retrofit - Efficient Lighting				
	h.12 (43)	Retrofit - Building Envelope				
	h.13 (44)	Retrofit - Alternative Energy				
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard				
	i.2 (47)	Impurity/Contamination				
	i.3 ( )	Leaky/Stuck Damper				
	i.4 ( )	Leaky/Stuck Valve				
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13303 - MSU Mankato-Ford Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.3 (3)	Lighting is on more hours than necessary.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	b.3 (7)	OTHER_Economizer/OA Loads	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.4 (11)	OTHER_Controls	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	X	Efs		See ECO documentation for results
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.6 (17)	Other_Controls (Setpoint Changes)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.6 (22)	Other_Controls (Reset Schedules)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.2 (24)	Pump Discharge Throttled	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.3 (25)	Over-Pumping	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.4 (26)	Equipment is oversized for load.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.1 (28)	VFD Retrofit - Fans	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13303 - MSU Mankato-Ford Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.3 (30)	VFD Retrofit - Motors (process)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.4 (31)	OTHER_VFD	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
h. Retrofits:	h.1 (32)	Retrofit - Motors	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.2 (33)	Retrofit - Chillers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.4 (35)	Retrofit - Boilers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.5 (36)	Retrofit - Packaged Gas fired heating	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.6 (37)	Retrofit - Heat Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.7 (38)	Retrofit - Equipment (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.8 (39)	Retrofit - Pumping distribution method	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.9 (40)	Retrofit - Energy/Heat Recovery	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.10 (41)	Retrofit - System (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.11 (42)	Retrofit - Efficient Lighting	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.12 (43)	Retrofit - Building Envelope	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.13 (44)	Retrofit - Alternative Energy	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.14 (45)	OTHER_Retrofit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.2 (47)	Impurity/Contamination	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.3 ( )	Leaky/Stuck Damper	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.4 ( )	Leaky/Stuck Valve	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.5 (48)	OTHER_Maintenance	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
j. OTHER	j.1 (49)	OTHER	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13304 - MSU Mankato-Memorial Library

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	AHU		See ECO documentation for results
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Pumps		See ECO documentation for results
	a.3 (3)	Lighting is on more hours than necessary.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	AHU		See ECO documentation for results
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	b.3 (7)	OTHER_Economizer/OA Loads	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.4 (11)	OTHER_Controls	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.6 (17)	Other_Controls (Setpoint Changes)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	X	AHU		See ECO documentation for results
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.6 (22)	Other_Controls (Reset Schedules)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.2 (24)	Pump Discharge Throttled	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.3 (25)	Over-Pumping	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.4 (26)	Equipment is oversized for load.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.1 (28)	VFD Retrofit - Fans	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13304 - MSU Mankato-Memorial Library

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.3 (30)	VFD Retrofit - Motors (process)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.4 (31)	OTHER_VFD	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
h. Retrofits:	h.1 (32)	Retrofit - Motors	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.2 (33)	Retrofit - Chillers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.4 (35)	Retrofit - Boilers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.5 (36)	Retrofit - Packaged Gas fired heating	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.6 (37)	Retrofit - Heat Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.7 (38)	Retrofit - Equipment (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.8 (39)	Retrofit - Pumping distribution method	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.9 (40)	Retrofit - Energy/Heat Recovery	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.10 (41)	Retrofit - System (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.11 (42)	Retrofit - Efficient Lighting	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.12 (43)	Retrofit - Building Envelope	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.13 (44)	Retrofit - Alternative Energy	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.14 (45)	OTHER_Retrofit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.2 (47)	Impurity/Contamination	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.3 ( )	Leaky/Stuck Damper	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.4 ( )	Leaky/Stuck Valve	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.5 (48)	OTHER_Maintenance	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
j. OTHER	j.1 (49)	OTHER	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13305 - MSU Mankato-Morris Hall (excluding addition)

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	AHU		See ECO documentation for results
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.3 (3)	Lighting is on more hours than necessary.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	AHU		See ECO documentation for results
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	b.3 (7)	OTHER_Economizer/OA Loads	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.4 (11)	OTHER_Controls	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.6 (17)	Other_Controls (Setpoint Changes)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	X	AHU		See ECO documentation for results
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.6 (22)	Other_Controls (Reset Schedules)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.2 (24)	Pump Discharge Throttled	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.3 (25)	Over-Pumping	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.4 (26)	Equipment is oversized for load.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.1 (28)	VFD Retrofit - Fans	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

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Rev. 2.0 (12/16/2010)

13305 - MSU Mankato-Morris Hall (excluding addition)

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.3 (30)	VFD Retrofit - Motors (process)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.4 (31)	OTHER_VFD	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
h. Retrofits:	h.1 (32)	Retrofit - Motors	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.2 (33)	Retrofit - Chillers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.4 (35)	Retrofit - Boilers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.5 (36)	Retrofit - Packaged Gas fired heating	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.6 (37)	Retrofit - Heat Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.7 (38)	Retrofit - Equipment (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.8 (39)	Retrofit - Pumping distribution method	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.9 (40)	Retrofit - Energy/Heat Recovery	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.10 (41)	Retrofit - System (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.11 (42)	Retrofit - Efficient Lighting	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.12 (43)	Retrofit - Building Envelope	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.13 (44)	Retrofit - Alternative Energy	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.14 (45)	OTHER_Retrofit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.2 (47)	Impurity/Contamination	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.3 ( )	Leaky/Stuck Damper	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.4 ( )	Leaky/Stuck Valve	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.5 (48)	OTHER_Maintenance	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
j. OTHER	j.1 (49)	OTHER	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

Investigation Checklist

PBEEEP State Government

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13306 - MSU Mankato-Nelson Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	X	AHU/RTU		See ECO documentation for results
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Pumps		See ECO documentation for results
	a.3 (3)	Lighting is on more hours than necessary.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	X	AHU/RTU		See ECO documentation for results
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	b.3 (7)	OTHER_Economizer/OA Loads	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.4 (11)	OTHER_Controls	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.6 (17)	Other_Controls (Setpoint Changes)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	X	AHU		See ECO documentation for results
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.6 (22)	Other_Controls (Reset Schedules)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.2 (24)	Pump Discharge Throttled	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.3 (25)	Over-Pumping	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.4 (26)	Equipment is oversized for load.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.1 (28)	VFD Retrofit - Fans	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

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13306 - MSU Mankato-Nelson Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.3 (30)	VFD Retrofit - Motors (process)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.4 (31)	OTHER_VFD	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
h. Retrofits:	h.1 (32)	Retrofit - Motors	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.2 (33)	Retrofit - Chillers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.4 (35)	Retrofit - Boilers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.5 (36)	Retrofit - Packaged Gas fired heating	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.6 (37)	Retrofit - Heat Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.7 (38)	Retrofit - Equipment (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.8 (39)	Retrofit - Pumping distribution method	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.9 (40)	Retrofit - Energy/Heat Recovery	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.10 (41)	Retrofit - System (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.11 (42)	Retrofit - Efficient Lighting	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.12 (43)	Retrofit - Building Envelope	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.13 (44)	Retrofit - Alternative Energy	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.14 (45)	OTHER_Retrofit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.2 (47)	Impurity/Contamination	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.3 ( )	Leaky/Stuck Damper	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.4 ( )	Leaky/Stuck Valve	X	AHU		See ECO documentation for results
	i.5 (48)	OTHER_Maintenance	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
j. OTHER	j.1 (49)	OTHER	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

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13307 - MSU Mankato-Utility Plant

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	Chillers. Pumps		See ECO documentation for results
	a.3 (3)	Lighting is on more hours than necessary.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	b.3 (7)	OTHER_Economizer/OA Loads	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.4 (11)	OTHER_Controls	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	X	Pumps		See ECO documentation for results
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.6 (17)	Other_Controls (Setpoint Changes)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.6 (22)	Other_Controls (Reset Schedules)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.2 (24)	Pump Discharge Throttled	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.3 (25)	Over-Pumping	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.4 (26)	Equipment is oversized for load.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.1 (28)	VFD Retrofit - Fans	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13307 - MSU Mankato-Utility Plant

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.3 (30)	VFD Retrofit - Motors (process)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.4 (31)	OTHER_VFD	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
h. Retrofits:	h.1 (32)	Retrofit - Motors	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.2 (33)	Retrofit - Chillers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.4 (35)	Retrofit - Boilers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.5 (36)	Retrofit - Packaged Gas fired heating	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.6 (37)	Retrofit - Heat Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.7 (38)	Retrofit - Equipment (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.8 (39)	Retrofit - Pumping distribution method	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.9 (40)	Retrofit - Energy/Heat Recovery	X	Boilers		See ECO documentation for results
	h.10 (41)	Retrofit - System (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.11 (42)	Retrofit - Efficient Lighting	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.12 (43)	Retrofit - Building Envelope	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.13 (44)	Retrofit - Alternative Energy	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.14 (45)	OTHER_Retrofit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.2 (47)	Impurity/Contamination	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.3 ( )	Leaky/Stuck Damper	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.4 ( )	Leaky/Stuck Valve	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.5 (48)	OTHER_Maintenance	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
j. OTHER	j.1 (49)	OTHER	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13308 - MSU Mankato-Wiecking Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	X	AHU-RTU		See ECO documentation for results
	a.3 (3)	Lighting is on more hours than necessary.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	X	AHU		See ECO documentation for results
	b.3 (7)	OTHER_Economizer/OA Loads	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	c.4 (11)	OTHER_Controls	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	d.6 (17)	Other_Controls (Setpoint Changes)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	X	AHU		See ECO documentation for results
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	e.6 (22)	Other_Controls (Reset Schedules)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.2 (24)	Pump Discharge Throttled	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.3 (25)	Over-Pumping	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.4 (26)	Equipment is oversized for load.	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.1 (28)	VFD Retrofit - Fans	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

PBEEEP State Government

Rev. 2.0 (12/16/2010)

13308 - MSU Mankato-Wiecking Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.3 (30)	VFD Retrofit - Motors (process)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	g.4 (31)	OTHER_VFD	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
h. Retrofits:	h.1 (32)	Retrofit - Motors	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.2 (33)	Retrofit - Chillers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.4 (35)	Retrofit - Boilers	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.5 (36)	Retrofit - Packaged Gas fired heating	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.6 (37)	Retrofit - Heat Pumps	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.7 (38)	Retrofit - Equipment (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.8 (39)	Retrofit - Pumping distribution method	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.9 (40)	Retrofit - Energy/Heat Recovery	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.10 (41)	Retrofit - System (custom)	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.11 (42)	Retrofit - Efficient Lighting	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.12 (43)	Retrofit - Building Envelope	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.13 (44)	Retrofit - Alternative Energy	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	h.14 (45)	OTHER_Retrofit	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.2 (47)	Impurity/Contamination	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.3 ( )	Leaky/Stuck Damper	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.4 ( )	Leaky/Stuck Valve	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
	i.5 (48)	OTHER_Maintenance	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.
j. OTHER	j.1 (49)	OTHER	-	-	Investigation looked for, but did not find this issue.	None of the equipment investigated fell within this finding type.

Deleted Findings Summary

Site: MSU Mankato

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	Armstrong Hall	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	$0	$0	0.00	$0	0.00	0
6	Armstrong Hall	VAV Box Minimum Flow Setpoint is higher than necessary	$0	$0	0.00	$0	0.00	0
2	Centennial Student Union	SF-23 Supply Air Temperature Reset	$0	$0	0.00	$0	0.00	0
3	Morris Hall	SF-1 Static Reset	$0	$0	0.00	$0	0.00	0
4	Morris Hall	Radiation Pump Runtime Reduction	$0	$0	0.00	$0	0.00	0
2	Nelson w/addition	AHU/RTU Optimize Economizer	$0	$0	0.00	$0	0.00	0
3	Nelson w/addition	SF-1 Supply Air Temperature Reset	$0	$0	0.00	$0	0.00	0
4	Nelson w/addition	SF-1 Leaky/Stuck Chilled Water Valve	$0	$0	0.00	$0	0.00	0
2	Utility Plant	Chiller-2 (1200 Ton Trane) is staged based on percentage of load (66%) in lieu of actual demand.	$0	$0	0.00	$0	0.00	0
3	Utility Plant	Chiller-3 (1000 Ton Trane) is staged based on percentage of load (66%) in lieu of actual demand.	$0	$0	0.00	$0	0.00	0
4	Utility Plant	Chiller-1 (McQuay) condenser water reset for best efficiency.	$0	$0	0.00	$0	0.00	0
5	Utility Plant	Chiller-2 (1200 Ton Trane) condenser water reset for best efficiency.	$0	$0	0.00	$0	0.00	0
6	Utility Plant	Chiller-3 (1000 Ton Trane) condenser water reset for best efficiency.	$0	$0	0.00	$0	0.00	0
7	Utility Plant	Optimize Cooling tower performance	$0	$0	0.00	$0	0.00	0
8	Utility Plant	CP-1A and CP-1B: Optimize Secondary chilled water pumps startup based on demand from equipment.	$0	$0	0.00	$0	0.00	0
9	Utility Plant	CP-1A and CP-1B: Optimize Secondary chilled water pumps ramping based on demand from equipment.	$0	$0	0.00	$0	0.00	0

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Summary

Site: MSU Mankato

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
10	Utility Plant	CP-1A and CP-1B: Optimize lead/lag sequencing based on demand.	$0	$0	0.00	$0	0.00	0
11	Utility Plant	Chiller Evaporator Pumps: CP-1, CP-2 and CP-3 runtime reduction	$0	$0	0.00	$0	0.00	0
12	Utility Plant	Chiller Condenser Water pumps CP-3A, CP-3B and CP-3C runtime reduction	$0	$0	0.00	$0	0.00	0
14	Utility Plant	Boiler-1 and Boiler-4: Optimize efficiencies	$0	$0	0.00	$0	0.00	0
15	Utility Plant	Boiler-1 and Boiler-4: Optimize efficiencies	$0	$0	0.00	$0	0.00	0
16	Utility Plant	Cooling Tower Optimization	$0	$0	0.00	$0	0.00	0
2	Wiecking Center	AHU/RTU Optimize Economizer	$0	$0	0.00	$0	0.00	0
4	Wiecking Center	AHU Outside Air Reduction	$0	$0	0.00	$0	0.00	0
		Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
		Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

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Deleted Findings Summary

Building: Armstrong Hall
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	$0	$0	0.00	$0	0.00	0
6	VAV Box Minimum Flow Setpoint is higher than necessary	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

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Deleted Findings Details

Building: Armstrong Hall

FWB Number:	13301	Eco Number:	3
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	Date Identified:	3/21/2011
Description of Finding:	Currently the duct static pressure is at a constant setpoint of 1.0"wc for SF-1 and SF-2 (ECO-3 and ECO-8). Through observation, typically the VAV box dampers are at 40-60% open. Recommend implementation of supply air duct static pressure reset.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	Reviewed damper positions throughout the system.		
Measure:	Modify the existing control programming of allow the supply duct static pressure to float between two setpoints based on the VAV box damper position. Proposed savings of 1,064 kWh after interactions, 4 kW at a cost of $2,016 for the ocntractoro and $960 for the provider.		
Recommendation for Implementation:	Modify the control sequence programming for SF-1 and SF-2 to allow the supply air duct static pressure to float between a minimum and maximum based on the VAV box damper position. When a 10% (adj) of VAV box dampers are at 100% open, start to migrate the supply duct static pressure from minimum (adj) to maximum (adj) based on time. Initially these minimum is to be set at 0.75"wc and maximum at 1.00"wc. Once 95% (adj) of the VAV box damper have closed below 80% (adj) damper position, the supply duct static pressure will reduce from maximum to minimum.		
Evidence of Implementation Method:	Review control sequence program modifications by performing functional testing of the control sequence programming. During the testing period establish which VAV boxes control the changes in supply duct static pressure and trend the damper positions for a minimum period of two weeks to confirm that the VAV box flow rate setpoints are being maintained.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Armstrong Hall

FWB Number:	13301	Eco Number:	6
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	VAV Box Minimum Flow Setpoint is higher than necessary	Date Identified:	3/21/2011
Description of Finding:	The Series Fan Powered VAV boxes have the primary damper CFM setpoint for the heating mode set to maximum. Recommend that this is set to minimum CFM flow for occupied minimum OA. ECO-14		
Equipment or System(s):	VAV terminal unit	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Implement by in-house staff or controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	Review BAS programming during occupied heating conditions.		
Measure:	Modify the programming for the VAV box heating CFM setpoint during occupied conditions. Proposed savings of 13,348 kWh after interactions, 35 kW, and 3,327 Therms at a cost of $1,008 for the contractor and $960 for the provider.		
Recommendation for Implementation:	Modify control setpoints for the Fan Powered VAV boxes heating (maximum and minimum) CFM flow rates such that when the VAV box is in heating mode the CFM flow setpoints are set to a value of 30% of the maximum cooling setpoint.		
Evidence of Implementation Method:	Review programming of VAV boxes and perform functional testing. Trend the VAV box CFM flow rates and space temperatures for a minimum of two weeks. Verify that when the space temperature is in heating mode, the VAV box CFM setpoint is 30% of the maximum cooling CFM setpoint.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Summary

Building: Centennial Student Union
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	SF-23 Supply Air Temperature Reset	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

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Deleted Findings Details

Building: Centennial Student Union

FWB Number:	13302	Eco Number:	2
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	SF-23 Supply Air Temperature Reset	Date Identified:	8/18/2011
Description of Finding:	Recommend implementation of programming to provided AHU Supply Air Reset based on the space temperature demands for heating and cooling. ECO as listed: SF-23 = ECO-2		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the AHUs discharge air temperature and discharge air temperature setpoint.		
Measure:	Modify the existing control programming of allow the supply air temperature to float between a minimum and maximum setpoint based on demand. Proposed savings of 2,679 kWh after interactions, 11 kW, and 2,831 Therms at a cost of $2,016 for the contractor and $960 for the provider.		
Recommendation for Implementation:	Modify the existing control programming for SF-1 to allow the supply air temperature to float between a minimum (55 degF - adj) and maximum (70 degF - adj) setpoint based on cooling demand. Monitor the space temperatures being served by the AHU, once 20% (adj) of the space temperature require cooling, allow the supply air temperature setpoint to step from maximum to minimum. Once the space temperature cooling demand has dropped below 5% allow the supply air temperature setpoint to step from minimum to maximum.		
Evidence of Implementation Method:	Review control sequence program modifications and perform functional testing. Trend the number of cooling demand requests (or space temperatures) for a minimum of two weeks to verify that all of the spaces for meeting the required setpoints.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Summary

Building: Morris Hall
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	SF-1 Static Reset	$0	$0	0.00	$0	0.00	0
4	Radiation Pump Runtime Reduction	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Morris Hall

FWB Number:	13305	Eco Number:	3
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	SF-1 Static Reset	Date Identified:	6/2/2011
Description of Finding:	Fan is trying to make duct static pressure of 3.5" wc at measured at the fan. Recommend relocation of static pressure sensor to 2/3rd down duct or on second floor and establish a duct pressure reset schedule of 1.25"wc based on damper position.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Can be implemented by contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By reviewing the trending of SF-1 HD Static pressure and the BAS software.		
Measure:	Relocate the duct static pressure sensor for the hot deck to 2/3 downstream of the flow capacity. Install an additional static pressure sensor in the cold deck in a similar location. Proposed savings of 5,974 kWh after interactions, 109 kW, and 0 Therms at a cost of $5,767 for the contractor and $920 for the provider.		
Recommendation for Implementation:	Relocate the duct static pressure sensor for the hot deck to 2/3 downstream of the flow capacity. Install an additional static pressure sensor in the cold deck in a similar location.		
Evidence of Implementation Method:	Review control sequence BAS screen for verification that the modifications for the static pressure setpoints have been made. Review the location of the hot deck and cold deck static pressure sensors. Trend the hot deck and cold deck static pressure sensors at 15 minute intervals for a minimum of 2 week in the heating and cooling season. Verify that all of the VAV boxes are maintaining the correct flow rates at maximum flow when all VAV boxes are in full hot deck and then in full cold deck damper position.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Morris Hall

FWB Number:	13305	Eco Number:	4
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Radiation Pump Runtime Reduction	Date Identified:	6/2/2011
Description of Finding:	Currently the radiation pump is running by an outside air temperature enable/disable of 60 degF. Recommend that the outside air temperature enable/disable be reducted to 50 degF		
Equipment or System(s):	Pump, HW distribution	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Can be implemented by owner or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing and trend data		
Measure:	Currently the radiation pump is running by an outside air temperature enable/disable of 60 degF. Recommend that the outside air temperature enable/disable be reduced to 50 degF. Proposed savings of 1,995 kWh after interactions, 0 kW, and 0 Therms at a cost of $84 for the contractor and $920 for the provider.		
Recommendation for Implementation:	Modify the enable/disable outside air temperature setpoint to 50 degF for the radiation pumping system.		
Evidence of Implementation Method:	Review control sequence BAS screen to verify the modifications have been made. Complete functional testing and trend the pump enable/disable during a period of time when the outside air temperature will go through the new setpoint of 50 degF.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Summary

Building: Nelson w/addition
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	AHU/RTU Optimize Economizer	$0	$0	0.00	$0	0.00	0
3	SF-1 Supply Air Temperature Reset	$0	$0	0.00	$0	0.00	0
4	SF-1 Leaky/Stuck Chilled Water Valve	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Nelson w/addition

FWB Number:	13306	Eco Number:	2
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	AHU/RTU Optimize Economizer	Date Identified:	7/20/2011
Description of Finding:	Recommend modification of the economizer enable/disable setpoint from 68 degF to 71 degF. This modification is based on ASHRAE local climate zone. Each AHU/RTU ECO as listed: ECO-2 for SF-1 ECO-6 for RTU-2 ECO-8 for SF-5 ECO-10 for SF-6 ECO-12 for SF-7 ECO-14 for SF-8 ECO-16 for RU-1 ECO-18 for RU-2		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the AHUs mixed air damper position verses the outside air temperature and the BAS software.		
Measure:	Modification of the existing BAS economizer enable/disable setpoint. Proposed savings of 1,198 kWh after interactions, 6 kW, and 6,908 Therms at a cost of $84 for the contractor and $920 for the provider.		
Recommendation for Implementation:	Modify the economzier enable/disable setpoint for all AHUs and RTUs with economizer control from the existing value of 68 degF to the recommended value of 71 degF		
Evidence of Implementation Method:	Review control sequence BAS screen for verification that the modification of the ecomonizer enable/disable took place. Trend the damper position for each of the units during the outside air temperature of 71 degF to verify that the damper position transitioned between economizer and non-economizer.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

PBEEEP State Government

Building: Nelson w/addition

FWB Number:	13306	Eco Number:	3
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	SF-1 Supply Air Temperature Reset	Date Identified:	7/20/2011
Description of Finding:	Recommend implementation of programming to provided AHU Supply Air Reset based on the space temperature demands for heating and cooling. ECO as listed: SF-1 = ECO-3		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the AHUs discharge air temperature and discharge air temperature setpoint.		
Measure:	Modify the existing control programming of allow the supply air temperature to float between a minimum and maximum setpoint based on demand. Proposed savings of (1,409) kWh after interactions, (19) kW, and 509 Therms at a cost of $84 for the contractor and $920 for the provider.		
Recommendation for Implementation:	Modify the existing control programming for SF-1 to allow the supply air temperature to float between a minimum (55 degF - adj) and maximum (65 degF - adj) setpoint based on cooling demand. Monitor the space temperatures being served by the AHU, once 20% (adj) of the space temperature require cooling, allow the supply air temperature setpoint to step from maximum to minimum. Once the space temperature cooling demand has dropped below 5% allow the supply air temperature setpoint to step from minimum to maximum.		
Evidence of Implementation Method:	Review control sequence program modifications and perform functional testing. Trend the number of cooling demand requests (or space temperatures) for a minimum of two weeks to verify that all of the spaces for meeting the required setpoints.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

PBEEEP State Government

Building: Nelson w/addition

FWB Number:	13306	Eco Number:	4
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	SF-1 Leaky/Stuck Chilled Water Valve	Date Identified:	7/20/2011
Description of Finding:	Recommend repair of the chilled water valve such that when the BAS closes the valve to the 0% position, chilled water is not leaking by and reducing the supply air temperature below the supply air temperature setpoint. ECO-4 for SF-1		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	By function testing of the BAS programming. Forcing the chilled water valve to close and reviewing the supply air temperature compared to setpoint.		
Measure:	Repair chilled water valve such that the valve will close when the BAS requires the valve to be at 0% open.Proposed savings of 318 kWh after interactions, 10 kW, and 0 Therms at a cost of $84 for the contractor and $920 for the provider.		
Recommendation for Implementation:	Repair chilled water valve such that the valve will close when the BAS requires the valve to be at 0% open.		
Evidence of Implementation Method:	Functional test the chilled water valve control such that when the BAS requires the valve at 0% open, the supply air temperature is equal to the mixed air temperature.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Summary

PBEEEP State Government

Building: Utility Plant

Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Chiller-2 (1200 Ton Trane) is staged based on percentage of load (66%) in lieu of actual demand.	$0	$0	0.00	$0	0.00	0
3	Chiller-3 (1000 Ton Trane) is staged based on percentage of load (66%) in lieu of actual demand.	$0	$0	0.00	$0	0.00	0
4	Chiller-1 (McQuay) condenser water reset for best efficiency.	$0	$0	0.00	$0	0.00	0
5	Chiller-2 (1200 Ton Trane) condenser water reset for best efficiency.	$0	$0	0.00	$0	0.00	0
6	Chiller-3 (1000 Ton Trane) condenser water reset for best efficiency.	$0	$0	0.00	$0	0.00	0
7	Optimize Cooling tower performance	$0	$0	0.00	$0	0.00	0
8	CP-1A and CP-1B: Optimize Secondary chilled water pumps startup based on demand from equipment.	$0	$0	0.00	$0	0.00	0
9	CP-1A and CP-1B: Optimize Secondary chilled water pumps ramping based on demand from equipment.	$0	$0	0.00	$0	0.00	0
10	CP-1A and CP-1B: Optimize lead/lag sequencing based on demand.	$0	$0	0.00	$0	0.00	0
11	Chiller Evaporator Pumps: CP-1, CP-2 and CP-3 runtime reduction	$0	$0	0.00	$0	0.00	0
12	Chiller Condenser Water pumps CP-3A, CP-3B and CP-3C runtime reduction	$0	$0	0.00	$0	0.00	0
14	Boiler-1 and Boiler-4: Optimize efficiencies	$0	$0	0.00	$0	0.00	0
15	Boiler-1 and Boiler-4: Optimize efficiencies	$0	$0	0.00	$0	0.00	0
16	Cooling Tower Optimization	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Utility Plant

FWB Number:	13307	Eco Number:	2
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Chiller-2 (1200 Ton Trane) is staged based on percentage of load (66%) in lieu of actual demand.	Date Identified:	6/2/2011
Description of Finding:	The chillers are staged based on percent of capacity rather than needed flow or supply chilled water to campus. Investigating the possibility of stagging utilizing the campus demand.		
Equipment or System(s):	Chiller Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Functional Testing; Trending of Chilled Water system points. Utilitzing the "Point Trending" page of the spreadsheet, all points are trended based on the outside air temperature reference. The average load of the campus and average Kw of the chiller load where determined in columns AK and AL, plotted and used for the baseline load and Kw in the TMY "Calculations" page.		
Measure:	Measure-1, 2 and 3 are consolidated into one calculation represented in ECO-1		
Recommendation for Implementation:	See above		
Evidence of Implementation Method:	See above		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Utility Plant

FWB Number:	13307	Eco Number:	3
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Chiller-3 (1000 Ton Trane) is staged based on percentage of load (66%) in lieu of actual demand.	Date Identified:	6/2/2011
Description of Finding:	The chillers are staged based on percent of capacity rather than needed flow or supply chilled water to campus. Investigating the possibility of stagging utilizing the campus demand.		
Equipment or System(s):	Chiller Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Functional Testing; Trending of Chilled Water system points. Utilitzing the "Point Trending" page of the spreadsheet, all points are trended based on the outside air temperature reference. The average load of the campus and average Kw of the chiller load where determined in columns AK and AL, plotted and used for the baseline load and Kw in the TMY "Calculations" page.		
Measure:	Measure-1, 2 and 3 are consolidated into one calculation represented in ECO-1		
Recommendation for Implementation:	See above		
Evidence of Implementation Method:	See above		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

PBEEEP State Government

Building: Utility Plant

FWB Number:	13307	Eco Number:	4
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Chiller-1 (McQuay) condenser water reset for best efficiency.	Date Identified:	6/2/2011
Description of Finding:	The chiller manufacturer's are sending the efficiency curves for various condenser entering temperatures and at various chiller loads to determine the most efficient reset schedule for the condenser water chiller entering temperature.		
Equipment or System(s):	Chiller Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Review of manufacturer's provided efficiency curves and compare with energy usage of cooling towers to determine the near optimal condenser water temperature setpoint to chiller efficiency.		
Measure:	Measure abandon because the Owner has had maintenance issues during a reset schedule and has determined that 75 degF is the lowest condenser water temperature that the Trane Chillers can run and keep oil out of the refrigerant. Thus, 75 degF is the setpoint for the condenser water on all chillers.		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Utility Plant

FWB Number:	13307	Eco Number:	5
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Chiller-2 (1200 Ton Trane) condenser water reset for best efficiency.	Date Identified:	6/2/2011
Description of Finding:	The chiller manufacturer's are sending the efficiency curves for various condenser entering temperatures and at various chiller loads to determine the most efficient reset schedule for the condenser water chiller entering temperature.		
Equipment or System(s):	Chiller Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Review of manufacturer's provided efficiency curves and compare with energy usage of cooling towers to determine the near optimal condenser water temperature setpoint to chiller efficiency.		
Measure:	Measure abandon because the Owner has had maintenance issues during a reset schedule and has determined that 75 degF is the lowest condenser water temperature that the Trane Chillers can run and keep oil out of the refrigerant. Thus, 75 degF is the setpoint for the condenser water on all chillers.		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Utility Plant

FWB Number:	13307	Eco Number:	6
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Chiller-3 (1000 Ton Trane) condenser water reset for best efficiency.	Date Identified:	6/2/2011
Description of Finding:	The chiller manufacturer's are sending the efficiency curves for various condenser entering temperatures and at various chiller loads to determine the most efficient reset schedule for the condenser water chiller entering temperature.		
Equipment or System(s):	Chiller Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Review of manufacturer's provided efficiency curves and compare with energy usage of cooling towers to determine the near optimal condenser water temperature setpoint to chiller efficiency.		
Measure:	Measure abandon because the Owner has had maintenance issues during a reset schedule and has determined that 75 degF is the lowest condenser water temperature that the Trane Chillers can run and keep oil out of the refrigerant. Thus, 75 degF is the setpoint for the condenser water on all chillers.		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Utility Plant

FWB Number:	13307	Eco Number:	7
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Optimize Cooling tower performance	Date Identified:	6/2/2011
Description of Finding:	Condenser water setpoint is currently 75 degF without reset. The chiller manufacturer's are sending the efficiency curves for various condenser entering temperatures and at various chiller loads to determine the most efficient reset schedule for the condenser water chiller entering temperature.		
Equipment or System(s):	Cooling Tower	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Review of manufacturer's provided efficiency curves and compare with energy usage of cooling towers to determine the near optimal condenser water temperature setpoint to chiller efficiency.		
Measure:	Measure abandon because the Owner has had maintenance issues during a reset schedule and has determined that 75 degF is the lowest condenser water temperature that the Trane Chillers can run and keep oil out of the refrigerant. Thus, 75 degF is the setpoint for the condenser water on all chillers.		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Utility Plant

FWB Number:	13307	Eco Number:	8
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	CP-1A and CP-1B: Optimize Secondary chilled water pumps startup based on demand from equipment.	Date Identified:	6/2/2011
Description of Finding:	Currently, the chilled water plant is started based on outside air temperature of 55 degF. Investigate the possibility of utilizing the BAS to determine the demand for chilled water through monitoring of the chilled water valve positions for each of the building's AHUs. Once known, the chilled water plant would run based on that demand.		
Equipment or System(s):	Chiller Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Review the trending for the chilled water valves at buildings being investigated. Determine the outside air temperature that the demand based on chilled water valve position is starting to ramp.		
Measure:	Measure abandon because the secondary chilled water pumps are run in parallel during all load conditions above one chiller or 2000 gpm. This is the best sequence of operation for these pumps.		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Utility Plant

FWB Number:	13307	Eco Number:	9
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	CP-1A and CP-1B: Optimize Secondary chilled water pumps ramping based on demand from equipment.	Date Identified:	6/2/2011
Description of Finding:	Currently, there are two pressure differential sensors within the buildings that provide feedback to vary the pump speed of CP1-A and CP-1B. Investigate whether or not additional delta-P sensors would help to regulate the pump speed more efficiently.		
Equipment or System(s):	Chiller Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Review the flow rate at each of the chilled water coils in a particular building being investigated. Demand the pressure differential setpoint that would provide the proper flow rate in all coils.		
Measure:	Measure abandon because the secondary chilled water pumps are run in parallel during all load conditions above one chiller or 2000 gpm. This is the best sequence of operation for these pumps.		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

PBEEEP State Government

Building: Utility Plant

FWB Number:	13307	Eco Number:	10
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	CP-1A and CP-1B: Optimize lead/lag sequencing based on demand.	Date Identified:	6/2/2011
Description of Finding:	Currently, the pumps are started in parallel and ramped based on differential pressure. The secondary pumps are not staged such that the lead pumps starts, runs to capacity based on differential pressure sensors located at various buildings on campus and then the second (lag) pumps starts and run in parallel.		
Equipment or System(s):	Chiller Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Trend the status of CP-1A and CP-1B to determine when the are running.		
Measure:	Measure abandon because the secondary chilled water pumps are run in parallel during all load conditions above one chiller or 2000 gpm. This is the best sequence of operation for these pumps.		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Utility Plant

FWB Number:	13307	Eco Number:	11
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Chiller Evaporator Pumps: CP-1, CP-2 and CP-3 runtime reduction	Date Identified:	6/2/2011
Description of Finding:	The runtime of this equipment is based on the associated chiller operation. Applicable ECOs that vary the runtime of the associated chiller will have impact on this equipment. Thus, any reduction in chiller runtime will have a ECO calculation completed for this equipment.		
Equipment or System(s):	Pump, primary CHW (evap-only)	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Review trending of equipment to enable/disable evaporator pumps with associated chiller.		
Measure:	Measure abandon and all Kw saving incorporated into the chiller runtime reduction ECO-1.		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Utility Plant

FWB Number:	13307	Eco Number:	12
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Chiller Condenser Water pumps CP-3A, CP-3B and CP-3C runtime reduction	Date Identified:	6/2/2011
Description of Finding:	The runtime of this equipment is based on the associated chiller operation. Applicable ECOs that vary the runtime of the associated chiller will have impact on this equipment. Thus, any reduction in chiller runtime will have a ECO calculation completed for this equipment.		
Equipment or System(s):	Condenser Water Pump	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Review trending of equipment to enable/disable condenser pumps with chiller runtimes.		
Measure:	Measure abandon and all Kw saving incorporated into the chiller runtime reduction ECO-1.		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

Building: Utility Plant

FWB Number:	13307	Eco Number:	14
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Boiler-1 and Boiler-4: Optimize efficiencies	Date Identified:	3/25/2011
Description of Finding:	ECO-3: Investigated the possibility of using heat exchanger from the combustion stack gases to heat domestic HW and/or HW for reheats. Utilized outside vendor to determine the energy savings and type of reheat available for this applications. Review the "ECO Boiler Stack Heat Exchanger - CHP.docx" file for complete outline.		
Equipment or System(s):	Boiler Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Work with outside vendor to determine feasibility.		
Measure:	ECO-3: Investigated the possibility of using heat exchanger from the combustion stack gases to heat domestic HW and/or HW for reheats. Utilized outside vendor to determine the energy savings and type of reheat available for this applications. Review the "ECO Boiler Stack Heat Exchanger - CHP.docx" file for complete outline. Proposed savings of 0 kWh after interactions, 0 kW, and 208,795 Therms at a cost of $690,000 for the contractor and $48,30 for the provider.		
Recommendation for Implementation:	Review CHP documentation		
Evidence of Implementation Method:	Review CHP documentation and trend all points associated with the newly installed equipment.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

PBEEEP State Government

Building: Utility Plant

FWB Number:	13307	Eco Number:	15
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Boiler-1 and Boiler-4: Optimize efficiencies	Date Identified:	3/25/2011
Description of Finding:	Investigated the possibility of using boiler blowdown water heat exchanger to reheat the makeup water. Waiting for the information of the cost and ROI documentation from Combustion Heat and Power Inc.		
Equipment or System(s):	Boiler Plant	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	NA	Benefits:	NA
Baseline Documentation Method:	Work with outside vendor to determine feasibility.		
Measure:	Currently in place within boiler equipment		
Recommendation for Implementation:	NA		
Evidence of Implementation Method:	NA		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

Building: Utility Plant

FWB Number:	13307	Eco Number:	16
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	Cooling Tower Optimization	Date Identified:	6/2/2011
Description of Finding:	There is a condenser water bypass valve that is used to bypass the cooling towers when the condenser water is colder than setpoint during cooler outside air temperature conditions. Currently, the setpoint is the same as the cooling tower fan control. In this case, the two control loops are fighting each other; opening the bypass (bypassing the cooling towers) while ramping the tower fans.		
Equipment or System(s):	Cooling Tower	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	Controls Contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Review trending of bypass valve position verses cooling tower fan stagging.		
Measure:	Because of the type of valve (butterfly) and varying condenser flow conditions, the determination of impact on cooling tower energy savings for this ECO could not be calculated. Recommend that the bypass valve setpoint be 2-3 degF colder that the condenser water cooling tower control setpoint.		
Recommendation for Implementation:	Recommend that the tower bypass valve setpoint be 2-3 degF colder that the condenser water cooling tower control setpoint.		
Evidence of Implementation Method:	Functional testing and trend the tower bypass valve, tower supply and return temperatures at a 15 minute interval for a period of two weeks during outside air temperature of 60 - 80 degF		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Summary

Building: Wiecking Center
Site: MSU Mankato

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	AHU/RTU Optimize Economizer	$0	$0	0.00	$0	0.00	0
4	AHU Outside Air Reduction	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Wiecking Center

FWB Number:	13308	Eco Number:	2
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	AHU/RTU Optimize Economizer	Date Identified:	12/15/2011
Description of Finding:	Recommend modification of the economizer enable/disable setpoint from 66 degF to 71 degF. This modification is based on ASHRAE local climate zone. Each AHU/RTU ECO as listed:ECO-2 for SF-2 ECO-1 for SF-1 ECO-3 for SF-2 ECO-5 for SF-5 ECO-8 for SF-11 ECO-12 for S-12 ECO-14 for S-17 ECO-15 for S-18 ECO-16 for RTU-2 ECO-17 for RTU-6		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Can be implemented by in-house staff or contractor	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the AHUs mixed air damper position verses the outside air temperature and the BAS software.		
Measure:	Modification of the existing BAS economizer enable/disable setpoint. Proposed savings of 1,998 kWh after interactions, 7 kW, and 20,533 Therms at a cost of $168 for the contractor and $960 for the provider.		
Recommendation for Implementation:	Modify the economzier enable/disable setpoint for all AHUs and RTUs with economizer control from the existing value of 66 degF to the recommended value of 71 degF		
Evidence of Implementation Method:	Review control sequence BAS screen for verification that the modification of the ecomonizer enable/disable took place. Trend the damper position for each of the units during the outside air temperature of 71 degF to verify that the damper position transitioned between economizer and non-economizer.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Deleted Findings Details

Building: Wiecking Center

FWB Number:	13308	Eco Number:	4
Site:	MSU Mankato	Date/Time Created:	5/22/2012

Investigation Finding:	AHU Outside Air Reduction	Date Identified:	12/15/2011
Description of Finding:	Recommend repair of the mixed air/return air damp control such that the minimum outside air quantity is reduced to the required amount		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by PBEEEP		

Implementer:	Implemented by the controls contractor.	Benefits:	Energy Savings
Baseline Documentation Method:	By functional testing of the BAS programming and reviewing the trending of the AHU calculated outside air percentage.		
Measure:	Recommend repair of the mixed air/return air damp control such that the minimum outside air quantity is reduced to the required amount. Proposed savings of 377 kWh after interactions, 11 kW, and 686 Therms at a cost of $2,016 for the contractor and $960 for the provider.		
Recommendation for Implementation:	Recommend repair of the mixed air/return air damp control such that the minimum outside air quantity is reduced to the required amount		
Evidence of Implementation Method:	Review the control modifications and trend the return air, mixed air, supply air and outside air temperatures and the mixed air damper positions for a minimum of two weeks at 15 minute intervals during a period of time when the outside air temperature is less than 40 degF.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

Equipment Label	Notes
AH-SF1	There is a backdraft damper installed before the outside air dampers causing additional pressure drop and falsely increasing the OA/RA damper positioning. Took pictures.
AH-SF1	There is not optimal startup of the fan for heating or cooling.
AH-SF2	There is a backdraft damper installed before the outside air dampers causing additional pressure drop and falsely increasing the OA/RA damper positioning. Took pictures.
AH-SF3	There is a backdraft damper installed before the outside air dampers causing additional pressure drop and falsely increasing the OA/RA damper positioning. Took pictures.
AH-SF3	The manual shutoff valve in the steam piping is leaking steam.
Basement-1st Floor Reheat Pumps	The differential pressure sensors are located at the pump. Recommend installation towards the end of the system.
2nd - 3rd Floor Reheat Pumps	The differential pressure sensors are located at the pump. Recommend installation towards the end of the system.
AH Series Fan Powered VAV Boxes	The air side balancing was not completed after installation of new series fan powered VAV boxes for perimeter of 2nd/3rd floors because there is flow out of the air filter sections of the VAV box. Recommend air balancing of primary VAV damper and fan flow on VAV.
AH Series Fan Powered VAV Boxes	The hydronic balancing was not completed after installation of new series fan powered VAV boxes for perimeter of 2nd/3rd floors. Recommend hydronic balancing.
AH Series Fan Powered VAV Boxes	New Series Fan Powered VAV boxes do not have return air filters. Recommend installation of filters to protect fan and ductwork from contamination.
AH VAV Boxes	Recommend completing air balancing on 1st and 2nd floors. Off by more that 10%. 3rd floor tested okay.
AH VAV Boxes	If air balancing is contracted, recommend hydronic balancing at the same time.

Equipment Label	Notes
SU SF-1	Recommend verifying the control of the VFD. In review of the trending of the VFD control, the BAS what the VFD to be at 100% speed but the VFD speed is at ~45 hz and does not vary. Once operation of VFD is verified, recommend calibration of the OA AFMS. When the OA dampers are 100% open, the flow rate is ~14K CFM. The maximum unit CFM is rated at 25K.
SU SF-2	Recommend verification of the unit's airflow; verify capacity is 25K CFM as indicated by the unit's documentation. Recommend calibration of the OA AFMS. When the OA dampers are 100% open, the flow rate is ~3.5K CFM. The maximum unit CFM is rated at 25K.
SU SF-3	Recommend verification of the unit's airflow; verify capacity is 2,300 CFM as indicated by the unit's documentation.
SU SF-3	The cooling valve is leaking by. This unit serves a small stairway with south sun exposure so the fact that the cooling valve is not closing completely is not effecting the space. Recommend repairing the valve.
SU SF-5	Recommend verification of the unit's airflow; verify capacity is 5,500 CFM as indicated by the unit's documentation. Recommend calibration of the OA AFMS. When the OA dampers are 100% open, the flow rate is ~4,000 CFM. The maximum unit CFM is rated at 5,500.
SU SF-21	The hot water coil piping has a circulation pump that is running when the units heating has been disabled. Recommend repairing the control of the pump start/stop. Repair and implementation costs are beyond simple payback period limitations.
SU SF-21	Recommend verification of the unit's airflow; verify capacity is 10K CFM as indicated by the unit's documentation.
SU SF-21	The chilled water valve does not open completely. In review, the pneumatic actuator only completes 50% of its stroke. Opened the valve the remainder and the supply air temperature started to drop.
SU SF-25	Recommend reduction of OA to zero when no occupancy is scheduled.
SU SF-26	Currently, the fan is run 24/7 to maintain ventilation in the space for equipment maintenance. Recommend reduction of OA to zero when no occupancy is scheduled.
SU SF-27	Recommend verification of the unit's airflow; verify capacity is 8,400 CFM as indicated by the unit's documentation.
SU SF-30	Recommend verification of the unit's airflow; verify capacity is 28,600 CFM as indicated by the unit's documentation. Recommend calibration of the OA AFMS. When the OA dampers are 100% open, the flow rate is ~21K CFM. The maximum unit CFM is rated at 28,600.
SU SF-40	Recommend verification of the unit's airflow; verify capacity is 5,500 CFM as indicated by the unit's documentation. Recommend calibration of the OA AFMS. When the OA dampers are 100% open, the flow rate is ~4,000 CFM. The maximum unit CFM is rated at 5,500.

Equipment Label	Notes
MOR - SF-1	One section of the outside air damper does not open when commanded by BAS.
MOR - SF-1	The return air damper does not close when commaned by BAS.
MOR - SF-1	Return air is not regulated with a damper.
MOR - SF-1	It is recommended that the duct static pressure sensors be relocated to 2/3rd down duct. Also, this is a hot deck/cold deck system with only the hot deck duct static being measured and monitored. Recommend that the hot deck and cold deck be monitored and then reset based on the damper position of either deck damper.
MOR - SF-2	The return air damper for this unit is drawing air from the mechanical space and not from the area being served by the unit. Recommend ducting return air to space served by AHU to help the circulation of air and reduce contaminents into airstream from mechanical space.
MOR - VAV Boxes	Some of the VAV boxes are not in control and not making the required setpoint.
MOR HW Pumps	The location of the differential pressure sensor is at the pump. Recommend the sensor be placed at the middle to end of the piping system for better pump VFD control.

Equipment Label	Notes
NEL - RTU-2	Supply reset is currently programmed between 60-100 degF based on average reheat zone temperatures. Some of the reheat valves are open, thus the current reset is not optimal. Recommend reset of the supply air temperature be based on the heating/cooling requirements of the spaces.
NEL - SF-5	Supply reset is currently programmed between 60-100 degF based on average reheat zone temperatures. Some of the reheat valves are open, thus the current reset is not optimal. Recommend reset of the supply air temperature be based on the heating/cooling requirements of the spaces. NOTE: THE SIMPLE PAYBACK IS TOO LONG FOR AN ECO
NEL - SF-7	Supply reset is currently programmed at 60 degF. Recommend reset of the supply air temperature be based on the heating/cooling requirements of the spaces. NOTE: THE SIMPLE PAYBACK IS TOO LONG FOR AN ECO.
NEL - SF-8	Supply reset is currently programmed between 60-100 degF based on average reheat zone temperatures. Some of the reheat valves are open, thus the current reset is not optimal. Recommend reset of the supply air temperature be based on the heating/cooling requirements of the spaces. NOTE: THE SIMPLE PAYBACK IS TOO LONG FOR AN ECO
NEL - RU-2	Supply reset is currently programmed between 60-100 degF based on average reheat zone temperatures. Some of the reheat valves are open, thus the current reset is not optimal. Recommend reset of the supply air temperature be based on the heating/cooling requirements of the spaces. NOTE: THE SIMPLE PAYBACK IS TOO LONG FOR AN ECO
NEL - Unit Ventilators	The equipment was installed during original building construction ~1962. The equipment is run for heating and cooling but because of the age, the equipment is beyond its median service life.
NEL - Exhaust Fans	All of the exhaust fans except the elevator are controlled by the end user. Recommend that the BAS control the EF to allow a sweep off during unoccuiped times.

Recommissioning Study for: MSU Mankato
Vendor: Hallberg Engineering
Xcel Energy Account Manager:

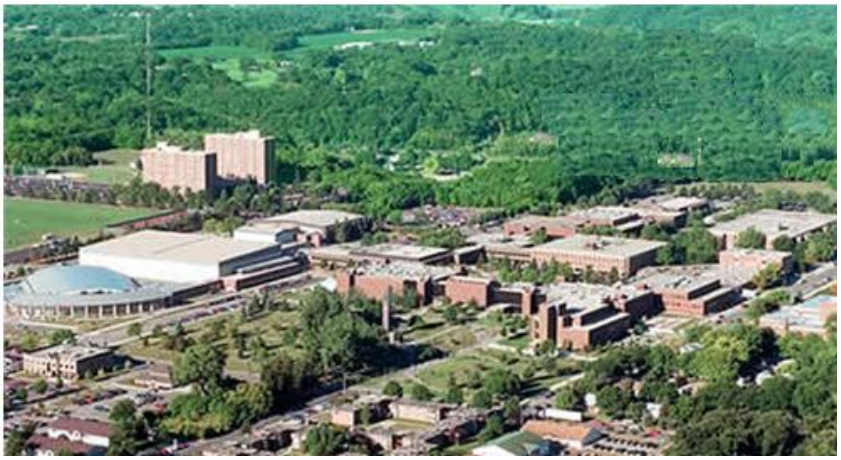
The application is acceptable. Xcel Energy will provide **$54,725.00** towards the study.

	Funding
Armstong Hall	$ 8,775.00
Centennial SU	$ 12,850.00
Ford Hall	$ 4,075.00
Memorial Library	$ 10,150.00
Memorial Library Addition	$ 4,875.00
Morris hall	$ 2,700.00
Nelson Hall	$ 3,150.00
Nelson Hall Add	$ 775.00
Utility Plant	$ 625.00
Wiecking Ctr	$ 5,975.00
Wiecking Shop bldg	$ 775.00
	$ 54,725.00

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR MINNESOTA STATE UNIVERSITY MANKATO (ENTIRE CAMPUS)



MINNESOTA STATE UNIVERSITY MANKATO

Minnesota STATE COLLEGES & UNIVERSITIES

January 27, 2011

Campus Overview

Minnesota State University Mankato	
Location	118 Wiecking Center, Mankato, MN 56001
Facility Manager	Paul Corcoran, Physical Plant Director
Number of Buildings	43
Interior Square Footage	2,768,139
PBEEEP Provider	Center for Energy and Environment (Angela Vreeland and Neal Ray)
Date Visited	9/16/2010, 10/7/2010, 10/19/2010
Annual Energy Cost	$3,780,659 (from 2009 utility data)
Utility Company	Electric: Xcel Energy Natural Gas: Center Point Energy Fuel Oil: Unknown
Site Energy Use Index (EUI)	128 kBtu/sqft (from 2009 utility data)
Benchmark EUI (from B3)	145 kBtu/sqft

Minnesota State University (MSU) Mankato is comprised of 42 buildings ranging in size from 424 to 241,406 square feet. The total area of the buildings on the campus is 2,768,139 square feet. The campus has eleven office and/or classroom buildings, four housing buildings, a performing arts center, a utility plant, six storage buildings, an athletic complex, a field house, a library, a science center, a stadium, and a student union. Many of the buildings are attached to other buildings via open hallways or are additions to buildings. All of the buildings are located on campus, covering an area approximately eight blocks wide by five blocks long. There is a map of the campus showing the location of each building within the site at the end of this report.

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of MSU Mankato was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. Walk-throughs were conducted on September 16, 2010, October 7, 2010, and October 19, 2010 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

Recommendation

Due to the large size of the campus, it is recommended that the campus be divided into more than one group of buildings for the investigation phase of the PBEEEP process. The buildings have been grouped in the following manner:

Current Group- The buildings in this group are currently being recommended for investigation.

- ***Phase 1 (11 buildings, 898,247 sq ft)***

  This group includes buildings that were determined to have good potential for reducing energy use and/or have operational issues that the building staff would like addressed.

Future Groups- The remaining buildings are divided into two categories:

- ***Potential Candidates (12 buildings, 914,317 sq ft)***

  These buildings have potential for reducing energy use and may or may not be included in a future investigation.
- ***Poor Candidates (20 buildings, 955,575 sq ft)***

  These buildings are not recommended for investigation.

Each of the groups will include buildings that total one million interior square feet or less; consequently, there are two building groups that could be investigated through PBEEEP. The following tables list the buildings in each of the three groups. The floor areas listed in the tables have not been verified.

Phase 1 (11 buildings, 898,247 sq ft)

Building Name	State ID	Building Type	Area (sq ft)	Year Built
Armstrong Hall	E26071S0663	Academic/Admin	143,966	1964
Centennial Student Union	E26071S8066	Student Union	210,388	1967
Ford Hall	E26071S5465	Academic/Admin	66,783	2008
Memorial Library	E26071S0865	Academic/Admin	166,181	1967
Memorial Library Addition	E26071S2090	Academic/Admin	80,184	1992
Morris Hall	E26071S0966	Academic/Admin	44,325	1968
Nelson Hall	E26071S0460	Academic/Admin	51,617	1962
Nelson Hall Addition	E26071S1277	Academic/Admin	13,076	1979
Utility Plant	E26071S0560	Mechanical	10,442	1962
Wiecking Center	E26071S0158	Academic/Admin	98,224	1959
Wiecking Shop Bldg	E26071S1583	Academic/Admin	13,061	1987

The decision to recommend a potential candidate building for investigation will be based on current and future plans for building upgrades and uses. These buildings would be reevaluated in approximately six months if a second energy study is initiated.

Potential Candidates (12 buildings, 914,317 sq ft)

Building Name	State ID	Building Type	Area (sq ft)	Year Built
Andreas Theater Addition	E26071S10500	Academic/Admin	19,469	2000
Highland Center	E26071S9362	Athletics	92,710	1962
Highland Center Phase II Add.	E26071S10202	Athletics	37,570	2002
Highland North	E26071S10679	Athletics	37,116	1979
Myers Field House	E26071S10301	Athletics	82,308	2001
Pennington Hall	E26071S168	Athletics	17,514	1986
Performing Arts Center	E26071S0764	Academic/Admin	87,887	1967
Taylor Center	E26071S10100	Athletics	142,951	2000
Trafton East	E26071S2194	Academic/Admin	57,270	1994
Trafton Science Center	E26071S1070	Academic/Admin	224,864	1972
Wigley Administration Center	E26071S1177	Academic/Admin	48,933	1979
Wissink Hall	E26071S1786	Academic/Admin	65,725	1987

Poor Candidates (20 buildings, 955,575 sq ft)

Building Name	State ID	Building Type	Area (sq ft)	Year Built
Alumni Foundation Center	E26071S1888	Academic/Admin	17,400	1989
AMET Storage Bldg	E26071S10496	Storage/Maint.	1,440	2009
Andreas Observatory	E26071S1989	Academic/Admin	1,863	1990
Blakeslee Stadium	E26071S0260	Athletics	19,443	1963
Carkoski Commons**				
Center for Renewable Energy*	E26071S9610	Academic	7,585	2010
Crawford Center**	E26071S5058	Dormitory	241,406	1964
East Building	E26071S209	Storage/Maint.	3,700	2009
Gage Center-link/Commons	E26071S5466	Dormitory	50,400	1966
Gage Tower A	E26071S5366	Dormitory	110,300	1966
Gage Tower B	E26071S5266	Dormitory	110,300	1966
Julia Sears	Unknown	Dormitory	150,275	2008
McElroy Center**	E26071S5159	Dormitory	208,763	1964
Morris Hall Addition	E26071S1377	Academic/Admin	22,436	1979
Ostrander Bell Tower	E26071S9788	Academic/Admin	424	1988
Standeford Observatory	E26071S 2480	Academic/Admin	200	1982
Utility Plant Storage	E26071S2297	Storage/Maint.	500	1985
West Building	E26071S0109	Storage/Maint.	2,000	2009
West Road Paint Shop	E26071S2358	Storage/Maint.	1,540	1999
Wiecking Storage Bldg	E26071S9060	Storage/Maint.	5,600	1987

*NOTE: The Center for Renewable Energy is under construction at the time of this report and the project is not being commissioned due to the size of the building.

**NOTE: The square footages listed for Crawford and McElroy include Carkoski Commons, which is a dining hall that is located between Crawford and McElroy. The square footage for Carkoski Commons is unknown.

Details obtained through the screening process regarding Phase 1 and Potential Candidate buildings (all buildings except the "poor" candidates) are included in the following:

Mechanical Equipment

The Utility Plant contains both the central steam plant and the central chilled water plant for the campus. There are four steam boilers that provide 150 psi steam to the entire campus year-round. The steam from the central steam plant is routed to the buildings in underground tunnels. Some of the buildings have heat exchangers that transfer heat from the steam to hot water while some of the buildings use the steam directly to heat the spaces. All of the Phase 1 and Potential Candidate buildings use steam from the Utility plant. The Chiller Plant houses three water-cooled chillers. Each chiller has a cooling tower located outside of the building. There are three constant volume primary pumps and two variable volume secondary pumps that circulate chilled water throughout the campus to the buildings. There is also an air-cooled chiller in Ford Hall, a water-cooled chiller in Trafton Science Center, and two water-cooled chillers in Memorial Library. The chiller in Trafton and the two chillers in Memorial Library contribute to the central chilled water loop; however, the chillers in Memorial Library rarely operate. All of the Phase 1 and Potential Candidate buildings use chilled water from the Utility plant. The following table lists the key mechanical equipment in the Phase 1 and Potential Candidate buildings.

Mechanical Equipment Summary Table of Phase I and Potential Buildings			
Total	**Phase 1**	**Potential**	**Description**
3	2	2	Building Automation Systems (1 Andover system and 2 independent Johnson Controls Metasys systems)
~5,000	~1,400	~3,550	Points on the Automation Systems Available for Trending
23	11	12	Buildings
1,812,564	898,247	914,317	Interior Square Feet
113	52	61	Air Handlers
1	0	1	Rooftop Units
854	339	515	VAV Boxes
192	48	144	Exhaust Fans and Power Roof Ventilators
36	0	36	Laboratory Fume Hoods
58	27	31	Unit Heaters and Cabinet Unit Heaters
3	3	0	Make-up Air Units
7	6	1	Chillers
6	5	1	Cooling Towers
4	4	0	Steam Boilers (dual fuel- natural gas or fuel oil)
1	1	0	Electric Boiler
82	45	37	Pumps (HW, CHW, etc)
33	17	16	Heat Exchangers

Controls and Trending

There are three automation systems that control the equipment in the buildings on campus. There is an Andover system, which controls Trafton Science Center (North, South, and Center). There are also two Johnson Controls Metasys systems; one controls Sears and Ford Hall, the other controls the rest of the buildings on campus. The automation systems are capable of trending and the data can be exported in a usable format for spreadsheet analysis. The points for each building in the automation system are listed in the building summary tables below.

Lighting

The majority of interior lighting on campus is 32 Watt T8s and are controlled by manual switches.

Energy Use Index B3 Benchmark

The site Energy Use Index (EUI) is 128 kBtu/sqft, which is 12.3% lower than the B3 Benchmark of 146 kBtu/sqft. The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks. This indicates that MSU Mankato has the potential to further reduce its energy use.

Most of the buildings on campus are sub-metered and data was collected during the screening process to calculate the EUI for each building. The monthly electricity (kWh), natural gas (therms), and steam (lbs) use for each building had been measured and recorded since February 2009. The table below lists the EUI for all buildings that are being sub-metered. These values are approximate and the accuracy of the sub-metering data has not been verified. The EUIs do not include chilled water use because it was being measured for only a few of the buildings. The Phase 1 Buildings are highlighted in green, the Potential Candidate Buildings are highlighted in blue, and the Poor Candidate Buildings are not highlighted.

Building	Area (sqft)	kBtu July 2009-July 2010	EUI July 2009-July 2010
Alumni Foundation Center	17,400	1,146,144	66
Armstrong Hall	143,966	18,727,478	130
Blakeslee Stadium	19,443	1,735,084	89
Carkoski Commons	Unknown	13,661,562	Unknown
Centennial Student Union	210,388	26,303,016	125
Crawford	241,406	14,718,581	61
Ford Hall	66,783	20,241,672	303
Gage	271,000	45,093,366	166
Highland Center	130,280	18,975,057	146
Highland North	37,116	7,772,371	209
McElroy	208,763	13,388,181	64
Memorial Library w/ Addition	246,365	29,709,994	121
Morris Hall	44,325	7,175,016	162
Morris Hall Addition	22,436	2,879,600	128
Myers Field House	82,308	7,734,398	94
Nelson Hall	51,617	7,159,855	139
Nelson Hall Addition	13,076	1,831,674	140
Pennington Hall	17,514	278,282	16
Performing Arts Center	107,356	8,893,541	83
Julia Sears	150,275	9,769,325	65
Taylor Center	142,951	16,532,377	116
Trafton East	57,270	7,345,127	128
Trafton Science Center	224,864	41,981,546	187
Wiecking Center w/ Shop	111,285	9,697,441	87
Wigley Administration Center	48,933	3,675,680	75
Wissink Hall	65,725	4,939,801	75

Metering

The campus has a total of fourteen natural gas meters, five electric meters, and one fuel oil meter that are currently active. The Utility Plant has a natural gas and electric meter, but otherwise none of the buildings are individually metered. As mentioned in the previous section, most buildings on campus are sub-metered and the data can be exported in monthly reports to track energy use on a building by building basis.

Documentation

There is a significant amount of mechanical documentation, including building plans, equipment schedules, operations and maintenance manuals, balance reports, and control sequences, that are located in a plan room in Wiecking Center. Although the plans are well organized, many of the buildings have had multiple renovations over the years and locating the most recent information for a given building can be difficult. The campus keeps a maintenance log to document how each air handler is being operated and the capacity of the equipment. This can be a useful source of information for the energy investigation. Very little of the documentation is available in electronic form.

Reasons for Recommendations

There are many factors that are part of the decision to recommend an energy investigation of a building; at MSU Mankato the primary information that was used to determine which buildings should be investigated was the EUI that was calculated for each building based on sub-metering data. The table on page 7 shows the EUI of each building. The buildings recommended for this investigation all have elevated EUIs. Other characteristics were also taken into account during the building selection process:

- Proximity or connectedness to other building recommended for investigation
- Potential energy savings opportunities observed during screening phase
- Large square footage
- Level of control by the building automation system
- Equipment size and quantity
- Frequency and severity of comfort and/or control issues

From a campus-wide standpoint, there are two main reasons for recommending that MSU Mankato move forward with the investigation of a selection of buildings:

- The annual energy cost averages $1.37 per square foot; a reduction in this cost should support the cost of the energy investigation
- B3 data shows that while the campus is below the benchmark value, it is about 68% higher than the average of all buildings in the database.

Building Summary Tables

The following tables are based on information gathered from interviews with facility staff, building walk-throughs, automation system screen-captures, and equipment documentation. The purpose of these tables is to provide the size and quantity of equipment and the level of control present in each building. It is complete and accurate to the best of our knowledge. The summary tables are divided into two groups: Phase 1 and Potential Candidates. Summary tables are not provided for the Poor Candidates.

Phase 1Buildings

These buildings were determined to be good candidates for an energy investigation and are the first group of buildings recommended to move forward to the investigation phase of PBEEEP.

Armstrong Hall
State ID# E26071S0663

Area (sqft)	143,966	Year Built	1964	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
ARM SF1	VAV AHU with SF and RF with VFDs	52,425 cfm, 30 hp SF, 10 hp RF	CHW and steam, serves VAV boxes in East side of building.
ARM SF2	VAV AHU with SF and RF with VFDs	54,300 cfm, 30 hp SF, 10 hp RF	CHW and steam, serves VAV boxes in West side of building.
ARM SF3	Constant volume AHU with SF and RF	21,000 cfm, 20 hp SF, 5 hp RF	CHW and steam, serves the basement.
Basement 1st Reheat Pump	Variable Volume HWP with VFD	7.5 hp	
Floors 2 and 3 Reheat Pump	Variable Volume HWP with VFD	7.5 hp	
Soffit Radiation Pump	Constant Volume HWP	7 hp	
CHWP	Constant Volume CHWP		Not used, chilled water is distributed by the central system now
114 VAV boxes			51 of the boxes have HW reheat, the rest are cooling only.
16 VMA Boxes			
HW FTR			
3 Steam to HW HX	Steam to HW Converters		

Points on BAS- Armstrong Hall

Description	Points
ARM_SF1 ARM_SF2	SF command, SF status, RF command, RF status, Low limit alarm, Hi static alarm, MAT, Economizer status, MA damper %, Auxiliary relief dampers command, DAT, DAT setpoint, Heating valve %, Cooling valve %, RAT, RARH, RA enthalpy, Supply static pressure, Supply static pressure setpoint, SF speed, Return static pressure, Return static pressure setpoint, RF speed, Building static pressure, Building static pressure setpoint, Relief air damper %, SA cfm, RA cfm, Filter differential pressure, Steam coil DAT, Steam coil calculated DAT, Steam coil reheat valve %, VAV day/night control
ARM_SF3	SF command, SF status, RF status, MAT, MA damper %, Economizer status, DAT, DAT setpoint, Heating valve %, Cooling valve %, RAT, RARH, RA enthalpy, Space temperature, Space temperature setpoint
ARM_HTG	Pump status, HWST, HWST setpoint, OAT enable setpoint, Valve %,
ARM_CLG	Pump command, Pump status, Differential pressure setpoint, Differential pressure, CHWRT
VAV	Space temperature, DAT, cfm

Additional Comments

- This is a 3-story building with a basement that houses classrooms and offices.
- Chilled water and steam come from the Utility Plant.
- This building is on the Johnson Controls Metasys Building Automation System.
- This building was recommissioned within the last ten years.

Centennial Student Union
State ID# E26071S8066

Area (sqft)	210,388	Year Built	1967	Occupancy (hrs/yr)	6,552

HVAC Equipment

Description	Type	Size	Notes
SU SF1	VAV Multizone AHU with SF with VFD	25,000 cfm, 10 hp SF	Steam and CHW, serves VAV boxes in lower area.
SU SF2	Constant Volume Multizone AHU with SF	25,000 cfm, 10 hp SF	Steam and CHW, serves upper Hub area.
SU SF3	Constant Volume AHU with SF	2,300 cfm, 0.75 hp SF	Steam and CHW, serves grand stair.
SU SF4	VAV AHU with SF with VFD	8,400 cfm, 5 hp SF	Steam and CHW, serves VAV boxes in Ballroom 200 South.
SU SF5	VAV AHU with SF with VFD	5,500 cfm, 3 hp SF	Steam and CHW, Face/Bypass, serves VAV boxes in 2nd floor South conference rooms.
SU SF6	Constant Volume AHU with SF	6,200 cfm, 3 hp SF	Steam and CHW, serves East lobby on 2nd floor. *This unit is NOT on the BAS.*
SU SF7	VAV AHU with SF with VFD	8,400 cfm, 5 hp SF	Steam and CHW, serves VAV boxes in Ballroom 200 center.
SU SF8	Constant Volume AHU with SF	4,000 cfm, 2 hp SF	Steam and CHW, serves 2nd floor rooms. *This unit is NOT on the BAS.*

HVAC Equipment Cont'd- Centennial Student Union

Description	Type	Size	Notes
SU SF9	VAV AHU with SF with VFD	8,400 cfm, 5 hp SF	Steam and CHW, serves VAV boxes in Ballroom 200 North.
SU SF10	Constant Volume Multizone AHU with SF	2,400 cfm, 1.5 hp SF	Steam and CHW, serves 2nd floor Main Office.
SU SF21	VAV AHU with SF with VFD	10,000 cfm, 7.5 hp SF	Steam and CHW, serves VAV boxes in bowling alley.
SU SF22	Constant Volume AHU with SF	17,000 cfm, 10 hp SF	CHW only, serves game room. *This unit is NOT on the BAS.*
SU SF23	Constant Volume AHU with SF	14,150 cfm, 7.5 hp SF	Steam and CHW, serves bookstore and corridor.
SU SF24	Constant Volume AHU with SF	24,800 cfm, 15 hp SF	CHW only, serves 2nd floor West side.
SU SF25	VAV AHU with SF with VFD	6,600 cfm, 5 hp SF	CHW only, serves VAV boxes in East side of Auditorium.
SU SF26	VAV AHU with SF with VFD	6,900 cfm, 5 hp SF	CHW only, serves VAV boxes in West side of Auditorium.
SU SF27	Constant Volume AHU with SF	8,500 cfm, 5 hp SF	Steam and CHW, serves kitchen.
SU SF30	VAV AHU with SF with VFD and RF	28,600 cfm, 40 hp SF, 10 hp RF	Steam and CHW, serves VAV boxes in Phase III Building.
SU SF40	VAV AHU with SF and RF with VFDs	34,515 cfm, 50 hp SF, 15 hp RF	Steam and CHW, serves VAV boxes in the kitchen and dining areas
68 VAV boxes			HW reheat
20 PRVs	Powered Roof Ventilators	0.25 – 5 hp each	11 of the PRVs are between 1 and 5 hp.
2 EFs	Exhaust Fans	Less than 1 hp each	
RHTPMP	Constant Volume HWP	3 hp	Serves VAV reheats
HWP1	Constant Volume HWP	2 hp	
HWP2	Constant Volume HWP	5 hp	
HWP3	Constant Volume HWP	1.5 hp	Serves kitchen AHU (SU SF27)
CHWP	Variable Volume CHWP with VFD	30 hp	
10 Cabinet Unit Heaters			
HW FTR			
3 Steam to HW HX	Steam to HW Converters		

Points on BAS- Centennial Student Union

Description	Points
SU SF1	Occ/Unocc status, SF status, Aux OA damper status (open/closed), DSP, DSP setpoint, SF VFD speed, MAT, OA cfm, Econ damper position, Hot deck DAT, Calc hot deck DAT setpoint, Cold deck DAT, Calc cold deck DAT setpoint, Heating valve, Cooling valve, RAT, RARH, RA Enthalpy, Zone temps, Ave zone temps, VAV day/night control
SU SF2, SU SF10	Occ/Unocc status, SF status, Aux OA damper status (open/closed), MAT, OA cfm, Econ damper position, Hot deck DAT, Calc hot deck DAT setpoint, Cold deck DAT, Calc cold deck DAT setpoint, Heating valve, Cooling valve, RAT, RARH, RARH setpoint, Humidity valve, RA Enthalpy, Warmest zone temp, Coldest zone temp, Zone temps, Zone dampers (% heating)
SU SF3, SU SF23	Occ/Unocc status, SF status, Aux OA damper status (open/closed), MAT, Econ damper position, DAT, Heating valve, Face/bypass damper (not in SU SF23), Cooling valve, RAT, RARH, Zone temp, OAT
SU SF4, SU SF7, SU SF9, SU SF21, SU SF25, SU SF26	SF status, SF VFD speed, MAT, Econ damper position, DAT, Heating valve, Cooling valve, RAT, RARH, RARH setpoint, Humidity valve, Zone temp
SU SF5	Occ/Unocc status, SF status, MAT, OA cfm, Econ mode, DAT, DAT setpoint, Preheating valve, Face/bypass damper, Cooling valve, DSP, DSP setpoint, SF VFD speed, Ave zone temp, RAT, RARH, RA Enthalpy, VAV day/night control, Reheat pumps status
SU SF24	SF status, MAT, Econ damper position, DAT, DAT setpoint, Cooling valve, RAT, RARH, RARH setpoint, Humidity valve, RA Enthalpy
SU SF27	Occ/Unocc status, SF status, EF interlock, DAT, Calc DAT, Heating valve, Cooling valve, Zone temp, Heating coil HW temp, HWST, Converter OA enable setpoint, Pump status, Steam valve
SU SF30, SU SF40	Occ/Unocc, SF status, RF status, MAT, Econ damper position, Min Econ damper position, OA cfm, DAT, DAT setpoint, Face/bypass damper position, Preheat valve, Cooling valve, DSP, DSP setpoint, SF VFD speed, RF VFD speed (SU SF40 only), RAT, RARH, RARH setpoint, Humidity valve, RA Enthalpy, VAV day/night control, Aux OA damper position, CHWST, CHWRT, OAT, OARH, OA Enthalpy
VAV boxes	Space temp, VAV cfm
HW FTR	Valve, Space temp, Space temp setpoint
Heating System	OAT (from SF30), HWST, HWRT, HWST setpoint, HW Converter valve, HWP OA lockout temp, Pump status, HW reset low limit, HW reset high limit, OA reset low limit, OA reset high limit
Cooling System	Pump status, CHWRT, CHW GPM, CHW DP, CHW DP setpoint, CHWP VFD speed
Cabinet Unit Heaters	Space temp, Space temp setpoint, Status

Additional Comments- Centennial Student Union
• This 2-story building is a student union with a bowling alley, kitchen/dining area, offices, ballroom, auditorium, conference rooms, and a bookstore. • This building is on the Johnson Controls Metasys Building Automation System. Air handlers SU SF 6, 8, and 22 are NOT on the automation system. • Chilled water and steam come from the Utility Plant.

Ford Hall
State ID# E26071S5465

Area (sqft)	66,783	Year Built	2008	Occupancy (hrs/yr)	8,760

HVAC Equipment

Description	Type	Size	Notes
AHU 30	VAV AHU with SF with VFD and 2 EFs	27,325 cfm, 50 hp SF, 25 hp EFA, 25 hp EFB	HW only, enthalpy wheel between OA and EA air streams, serves VAV boxes.
AHU 31	VAV AHU with SF with VFD and 2 EFs	27,525 cfm, 50 hp SF, 25 hp EFA, 25 hp EFB	HW only, enthalpy wheel between OA and EA air streams, serves VAV boxes.
AHU 32	VAV AHU with SF with VFD and 2 EFs	27,363 cfm, 50 hp SF, 25 hp EFA, 25 hp EFB	HW only, enthalpy wheel between OA and EA air streams, serves VAV boxes.
AHU 33	VAV AHU with SF with VFD and 2 EFs	27,758 cfm, 50 hp SF, 25 hp EFA, 25 hp EFB	HW only, enthalpy wheel between OA and EA air streams, serves VAV boxes.
AHU 34	VAV AHU with SF with VFD	16,000 cfm, 10 hp SF	No HW or CHW, serves VAV boxes.
51 VAV boxes			HW reheat coils
FCU 1	Fan Coil Unit		CHW only
Chiller 1	Air-cooled Chiller	15 Tons	Serves animals and "cold rooms"
CHWP 1	Constant Volume CHWP	712 gpm	
Boiler 1	Electric Boiler	196 kBtu/hr output	
HWP 1	Variable Volume HWP	400 gpm, 5 hp	Primary HWP.
HWP 2	Variable Volume HWP	400 gpm, 5 hp	Primary HWP.
HWP 3	Variable Volume HWP	350 gpm, 10 hp	Serves reheat and radiation.
HWP 4	Variable Volume HWP	350 gpm, 10 hp	Serves reheat and radiation.
HWP 5	Constant Volume HWP	95 gpm, 2 hp	Serves AHU 30 heating coil.

HVAC Equipment Cont'd- Ford Hall

HWP 6	Constant Volume HWP	95 gpm, 2 hp	Serves AHU 31 heating coil.
HWP 7	Constant Volume HWP	95 gpm, 2 hp	Serves AHU 32 heating coil.
HWP 8	Constant Volume HWP	95 gpm, 2 hp	Serves AHU 33 heating coil.
HWP 9	Constant Volume HWP	20 gpm, 0.5 hp	Circulates HW from Boiler 1
15 EFs		EF 35 is 10 hp, the rest are less than 1 hp	
68 Lab Hoods			
HX 1	Steam to HW Converter		
HW FTR			

Points on BAS

Description	Points
AHU 30, AHU 31, AHU 32, AHU 33	SF status, EF status, Econ damper position, DA damper position, Humidification setpoint, Humidifier valve, Entering heat wheel DP, Preheat temp, Face/Bypass damper position, Preheat valve, Preheat pump status, Heating coil entering temp, Heating coil leaving temp, Cooling valve, DA cfm, Calc DAT setpoint, DAT, DARH, DA DSP setpoint, DA DSP, SF VFD speed, EA RH, EA DSP, EA DSP, OAT
AHU 34	Econ damper position, MAT, MAT setpoint, SF VFD speed, SF status, EF VFD speed, EF status, EA damper position, Zone temp, Zone temp setpoint
VAV boxes	Space temp
EFs	cfm
Lab Hoods	Face velocity, Face velocity setpoint, Sash open percent
Heating System	Boiler status, Pump status, HW DP, HW DP setpoint, Bypass valve position, Steam valve position, HW GPM through HX
Cooling System	CHWST, Chiller status, CHWRT, CHWP status
FCU 1	Cooling valve output, Fan status, Zone temp, Zone temp setpoint

Additional Comments

- There is a building pressurization unit that controls the pressure in the building. It consists of a damper and air flow measuring station.
- This 3-story building houses laboratories and is connected to Trafton. The two buildings are open to one another.
- This building is on the Johnson Controls Metasys Building Automation System.
- Chilled water and steam come from the Utility Plant.

Memorial Library w/ Addition State ID# E26071S0865/ E26071S2090					
Area (sqft)	246,365	Year Built	1967/ 1992	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
LIB SF1	VAV AHU with SF and RF with VFDs	40,000 cfm 30 hp SF 10 hp RF	CHW only, VAV system with reheats. Serves the basement and east end of the first floor
LIB SF2	VAV AHU with SF and RF, SF has a VFD	58,000 cfm 40 hp SF 15 hp RF	CHW only, VAV system with reheats. Serves the 2nd floor and east side of the 3rd floor
LIB SF3	VAV AHU with SF and RF, SF has a VFD	37,200 cfm 20 hp SF 7.5 hp RF	CHW only, VAV system with reheats. Serves the 1st, 2nd, and 3rd floors
LIB SF36	VAV AHU with SF and RF, SF has a VFD	80,000 cfm 40 hp SF (2) 10 hp RF (2)	HW and CHW, VAV system with reheats. Serves the West side addition
LIB CH1, LIB CH2	Water-cooled centrifugal chillers	360 Tons each	Feed into campus CHW loop, only used as needed during very hot weather, so they are rarely used.
P-1, P-2	New Converter Pumps	Unknown size	
P-3, P-4	Radiation Converter Pumps	1.5 hp each, 170 gpm each	
P-5, P-6	HWPs	15 hp 440 gpm each	Serve HW reheats
P-29	New Converter Cond Pump	Unknown size	
3 Liebert Units		20 Tons each	Serve computer center.
3 Steam to HW HX	Steam to HW Converters		

Points on BAS- Memorial Library w/ Addition

Description	Points
LIB SF1 LIB SF3	Occupancy, SF status, RF status, Low DAT alarm, Summer\Winter mode, MAT, DAT, Calculated DAT, Mixing damper %, Economizer mode, Cooling valve %, SF VFD speed, Minimum SF speed setpoint, Summer day setpoint, Summer nigh setpoint, Winter day setpoint, Winter night setpoint, RAT, RARH, RA humidifier setpoint, Humidity valve %, RA enthalpy, VAV day\night control, Cooling coil pump status, Chilled water pump differential pressure
LIB SF2	Occupancy, SF status, RF status, Low DAT alarm, MAT, DAT, DAT setpoint, Mixing damper %, Economizer mode, Cooling valve %, Static pressure, Static pressure setpoint, SF VFD speed, RAT, RARH, RA humidifier setpoint, Humidity valve %, RA enthalpy, Cooling coil pump control, Chilled water pump differential pressure, Average zone temp, VAV day\night control
LIB SF36	Occupancy, SF status, Low DAT alarm, Summer\winter mode, SF status, RF status, SF and RF speed, MAT, DAT, Calculated DAT, Heating valve %, RAT, Mixing damper, RARH, RA humidifier setpoint, Humidity valve %, RA enthalpy, Economizer mode, Cooling coil pump control, Cooling valve %, Chilled water pump differential pressure, Duct static pressure setpoint, Duct static pressure, Summer day RAT setpoint, Summer night RAT setpoint, Winter day RAT setpoint, Winter night RAT setpoint, VAV day\night control
VAV	Space temp, VAV flow
LIB CH1 LIB CH2	Chiller status, Percent rated load amps, CHWST, CHWRT, CDWST, CDWRT, Evaporator refrigerant pressure, Evaporator refrigerant temp, Compressor suction temp, Superheat temp, Evaporator pump status, Evaporator water flow switch, Evaporator low pressure status, Remote CHW reset status, Chilled water reset value
Radiation and Reheats	Space temp
Unit Heater	Status, Space temp
Exhaust Fan	EF command, EF status
Heating System	Converter pump command, Converter pump status, Pump differential pressure, HWST, HWST reset setpoint, HWRT, Converter steam valve %, OAT setpoint to enable HX
LIB LEB1 LIB LEB2	RAT, DAT, Glycol water entering temp, Glycol water leaving temp, General alarm, High temp alarm, Air flow alarm, Air filter alarm, Status, Power fail alarm

Additional Comments

- This library is a 3-story building with a basement.
- Chilled water and steam come from the Utility Plant.
- This building is on the Johnson Controls Metasys Building Automation System. The two chillers (LIB CH1 and LIB CH2) are listed under the Utility Plant.
- It is reported by facility staff that the windows in this building leak and there are comfort issues.

Morris Hall
State ID# E26071S0966

Area (sqft)	44,325	Year Built	1968	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
MOR SF1	VAV Multi-Zone AHU with SF with VFD	37,500 cfm, 40 hp SF	HW and CHW, serves VAV boxes in room 109, 203, and 221.
MOR SF2	Constant Volume Multi-Zone AHU with SF	5,050 cfm, 2 hp SF	CHW and HW reheat, serves 6 zones in the dental education area in basement.
MOR RT1	Constant Volume AHU with SF		DX cooling only, serves room 208.
35 VAV boxes			No HW reheat
Steam to HW HX	Steam to HW Converter		

Points on BAS

Description	Points
MOR SF1	Occupancy, SF command, SF status, Low limit alarm, MAT, Mixing dampers, Return dampers, Economizer mode, Hot deck DAT, Hot deck DAT low limit, Hot Deck calculated DAT, Heating valve %, Cold Deck DAT, Cold deck DAT low limit, Cold deck calculated DAT, Cooling valve %, Cooling pump command, RAT, Hot deck static pressure, Hot deck static pressure setpoint, SF VFD speed, VAV day/night control, RARH, IT data room temp
MOR SF2	Occupancy, SF status, MAT, Mixing damper, Economizer mode, DAT, DAT setpoint, Cooling valve %, RAT, Zone temp, Zone temp setpoint, Zone reheat valve
MOR RT1	Occupancy, Fan status, Zone temp, Zone temp setpoint, Cooling stage 1, cooling stage 2
VAV boxes	Space temp, Flow

Additional Comments

- This 2-story building with a basement that houses offices, classrooms, and a dental clinic.
- Chilled water and steam come from the Utility Plant.
- This building was built in two sections, the original building and an addition. The addition is not recommended for an energy investigation because the HVAC systems in that building are being completely replaced.
- This building is on the Johnson Controls Metasys Building Automation System.
- This building was recommissioned in 2008.

Nelson Hall w/ Addition State ID# E26071S0460/ E26071S1277					
Area (sqft)	64,693	Year Built	1962/ 1979	Occupancy (hrs/yr)	4,368

HVAC Equipment

Description	Type	Size	Notes
NEL SF1	Constant Volume Multi-Zone AHU with SF	7,200 cfm, 2 hp SF	CHW in AHU, HW reheat, serves classrooms 2, 3, and 4 in original building.
NEL RTU2	Constant Volume RTU with SF and RF	5,000 cfm, 1.5 hp SF	CHW and HW in RTU, HW reheat, serves Metals and Auto Shop in original building.
NEL SF5	VAV AHU with SF with VFD	3,000 cfm, 1 hp SF	HW and CHW, serves VAV boxes in Automotive Area in original building. This is unit is also referred to as SF4.
NEL SF6	Constant Volume AHU with SF	1,800 cfm, 1.5 hp SF	HW and CHW, serves the photo lab in original building. AHU is also called Photo Lab Fan.
NEL SF7	VAV AHU with SF with VFD	3,000 cfm, 1 hp SF	HW and CHW, serves VAV boxes in 1st floor offices and classrooms in original building.
NEL SF8	VAV AHU with SF and RF with VFDs	4,700 cfm, 3 hp SF	HW and CHW, serves VAV boxes in 2nd floor offices and classrooms in original building.
NEL MAU1	VAV MAU with SF with VFD	7,000 cfm, 5 hp SF	HW preheat and CHW, serves the 3rd floor classrooms in original building.
NEL DFU1	Constant Volume Direct-Fire MAU	Unknown	Serves Automotive Area in original building.
NEL RTU1	Constant Volume RTU with SF	Unknown	DX cooling, serves Computer Room in original building.
NELA RU1	Constant Volume RTU with SF	9,000 cfm 5 hp SF	Serves the addition ceramics art lab. Runs 24/7.
NELA RU2	Constant Volume RTU with SF	6,400 cfm 3 hp SF	Serves the addition art lab. Runs 24/7.
NELA RU3	Constant Volume RTU with SF	2,600 cfm 2 hp SF	Serves the addition art gallery. Runs 24/7.
VAV boxes			Unknown quantity, no HW reheat. Serve original building and addition.
NEL UV3, NEL UV4, NEL UV5, NEL UV6, NEL UV7	Unit Ventilators	Unknown	Heating and cooling units in original building.
3 CUHs	Cabinet Unit Heaters		Serve vestibules in Addition.
2 UHs	Unit Heaters		Serve Auto Shop in original building.
EFs	Exhaust Fans		Unknown quantity, estimated around 10.
HWP 1, HWP 2	Variable Volume HWPs with VFD	5 hp each	Located in original building.

HVAC Equipment Cont'd- Nelson Hall w/ Addition

Description	Type	Size	Notes
AUTO Pump-1 and 2	Constant Volume	1.5 hp each	
CHWP 1	CV CHWP		Serves Auto Wing in original building.
Radiation HWP	Constant Volume HWP	Unknown	Serves HW FTR in Addition.
HW FTR			In original building and addition.
2 Steam to HW HX	Steam to HW Converters		

Points on BAS

Description	Points
NEL SF1	Occupancy, SF command, SF status, Low DAT alarm, MAT, Economizer status, DAT, DAT setpoint, Cooling valve %, Space temp, Space temp setpoint, Reheat valve %, Radiation valve, RAT, RARH, RA enthalpy
NEL RTU2	Occupancy, SF command, SF status, RF command, RF status, Low limit alarm, Hi temp alarm, static pressure, static pressure setpoint, RF speed, MAT Mixed air damper, Calculated minimum damper position, Economizer status, DAT, Calculated DAT setpoint, DAT low limit, Cooling valve %, Heating valve %, Face/bypass damper %, Average zone temp, RA CO2, Air quality low limit, RAT, RARH, OA cfm, Space temp, Space temp setpoint, Space temp reheat valve
NEL SF5 NEL SF7	Occupancy, SF command, SF status, Low DAT alarm, MAT, MA damper %, Economizer status, DAT, DAT setpoint, Heating valve %, Cooling valve %, Lowest zone temp, RAT, RARH, RA enthalpy, Static pressure, Static pressure setpoint, SF speed
NEL SF6	Occupancy, SF command, SF status, Low DAT alarm, MAT, MA damper %, Economizer status, DAT, Heating valve %, Cooling valve %, RAT, RARH, RA enthalpy, Space temp, Space temp setpoint
NEL SF7	Occupancy, SF command, SF status, Low DAT alarm, MAT, MA damper %, Economizer status, DAT, DAT setpoint, Heating valve %, Cooling valve %, Lowest zone temp, RAT, RARH, RA enthalpy, Static pressure, Static pressure setpoint, SF speed
NEL SF8	Occupancy, SF command, SF status, RF command, RF status, Low DAT alarm, Hi static alarm, MAT, MA damper %, OA cfm, Minimum OA cfm setpoint, Economizer status, DAT, DAT setpoint, Heating valve %, Cooling valve %, Lowest zone temp, RAT, RARH, RA enthalpy, Static pressure, Static pressure setpoint, SF speed, RF speed, Supply fan Hz, PRV status, Room return air damper
NEL MAU1	Occupancy, SF status, Low limit alarm, Preheat temp, DAT, DAT setpoint, Preheat face/bypass, Preheat valve %, Cooling valve %, SF Speed, Building static pressure, Building static pressure setpoint, DA humidity, Room humidity, Room humidity setpoint, Humidity valve %
NEL RTU1	Occupancy, SF command, SF status, DAT, Space temp, Space temp setpoint, DX cooling stage 1
NEL DFU1	Status, DAT, Summer/winter switch, Summer/winter setpoint, PRV status
NEL UV3 NEL UV4 NEL UV5 NEL UV6 NEL UV7	Occupancy, System command, System status, Low limit alarm, DAT, MA damper, Space temp, Space temp setpoint, Cooling valve %, Radiation valve %, Heating valve %

Points on BAS Cont'd- Nelson Hall w/ Addition

Description	Points
VAV boxes	Space temp, Flow
HW FTR	Space temp, Space temp setpoint, Radiation valve
Heating System	OAT, OA hot water pump enable, HW differential pressure, HW differential pressure setpoint, HWP command, HWP status, HWP speed, HWST, Calculated HWST, Converter valve, HWRT, OAT low reset, OAT high reset, Hot water low reset, Hot water high reset
Auto Heating System	HWST, Calculated HWST, Converter Steam valve, OAT hot water pump enable, Pump command, Pump status
Cooling System	OA enable CHWP setpoint, CHWST, CHWST setpoint, CHWRT, CHWP command, CHWP status
Unit Heater, Cabinet Unit Heater	Space temp, Space temp setpoint, Unit status
NELA RU1	Occupancy, SF command, SF status, Low DAT alarm, Carbon monoxide alarm, MAT, MA damper %, Economizer status, DAT, Calculated DAT heating, DAT low limit heating, Preheat valve, Face/Bypass damper %, RAT, Space temp, Space temp setpoint, EF command, EF status
NELA RU2	System command, Summer/winter mode, DAT, RAT, Space temp, RARH, Economizer status, Cooling target temp, Heating target temp,
NELA RU3	SF command, SF status, DAT, Space temp, RAT

Additional Comments

- This 3-story building has a basement and houses offices, classrooms, and shops.
- Chilled water and steam come from the Utility Plant.
- This building is on the Johnson Controls Metasys Building Automation System.

Utility Plant State ID# E26071S0560					
Area (sqft)	10,442	Year Built	1962	Occupancy (hrs/yr)	8,736

HVAC Equipment

Description	Type	Size	Notes
UTL CH1	Water-cooled centrifugal chiller	1,000 Tons	
UTL CH2	Water-cooled centrifugal chiller	1,200 Tons	
UTL CH3	Water-cooled centrifugal chiller	1,000 Tons	
3 Cooling Towers	Cooling Towers	3,000 gpm, 3,720 gpm, 3,300 gpm	
CP 1A, CP 1B	Variable Volume CHWPs	200 hp each	These pumps circulate CHW through the secondary loop.
CP 1, CP 2A, CP 2B	Constant Volume Chiller Pumps	30 hp each	These pumps circulate CHW through the primary loop.
CP 3A, CP 3B	Constant Volume CDW Pumps	75 hp each	
Boiler 1	High-pressure steam boiler	108,000 kBtu/hr (35,000 lbs/hr)	VFD on the motor and stack economizer. Installed in 1962
Boiler 2	High-pressure steam boiler	Unknown Input (35,000 lbs/hr)	
Boiler 3	High-pressure steam boiler	Unknown Input (75,000 lbs/hr)	
Boiler 4	High-pressure steam boiler	Unknown Input (90,000 lbs/hr)	
MUA 1	Make-up Air Unit	Unknown	Serves steam tunnels
MUA 2	Make-up Air Unit	Unknown	Serves steam tunnels
1 EF	Exhaust Fan	Unknown	

Points on BAS

Description	Points
UTL CH1, UTL CH2, UTL CH3	Chiller enable, Chiller status, Chiller load percentage, CHWST, CHWST setpoint, CHWRT, Pump status, Evaporator refrigerant pressure, Evaporator refrigerant temp, CDWST, CDW supply flow, CDWRT, Condenser refrigerant pressure, Condenser refrigerant temp, Discharge refrigerant temp, Oil temp, Oil differential pressure, CDW isolation valve command
Cooling Towers	CDW header pressure, CDW header pressure setpoint, Condenser pump speed, CDWST, CDW bypass setpoint, CDW bypass valve, Cooling tower valve, Chiller Isolation valve command, Tower fan status, Tower fan command, CDW pump status, CDW pump command, Condenser filter pump status, Condenser filter pump command, CDWST setpoint, CDWST deadband, Pressure setpoint for chiller 1
Boiler 1, Boiler 2, Boiler 3, Boiler 4	Drum pressure, Steam flow, Gas flow, Feedwater flow, Fuel oil flow, Boiler efficiency, Boiler % oxygen, Deaerator pressure, Feedwater pressure, Feedwater temp, Stack temp
MUA 1, MUA 2	Status, DAT, Tunnel temp, MUA setpoint

Additional Comments- Utility Plant
• This building houses the central chiller and steam boiler plants for the entire campus. It also houses some office space. • This building is on the Johnson Controls Metasys Building Automation System. • There are more points for the chillers, the main ones are listed above, reference the points list on WorkZone to see a complete list.

Wiecking Center and Shop Building
State ID# E26071S0158/ E26071S1583

Area (sqft)	111,285	Year Built	1959/ 1987	Occupancy (hrs/yr)	2,340

HVAC Equipment

Description	Type	Size	Notes
WIEK SF1	Constant Volume AHU with SF	2,100 cfm, 0.5 hp SF	Steam and CHW, face/bypass, serves ROTC.
WIEK SF2	VAV AHU with SF with VFD	8,000 cfm, 3 hp SF	Steam and CHW, serves Auditorium.
WIEK SF3	Constant Volume AHU with SF	8,000 cfm, 7.5 hp SF	Steam only, serves store room.
WIEK SF5	VAV AHU with SF with VFD	4,850 cfm, 5 hp SF	Steam and 2-stage DX cooling, face/bypass, serves 5 VAV boxes in Graphics.
WIEK SF9	VAV AHU with SF with VFD	19,850 cfm, 20 hp SF	HW and 2-stage DX cooling, serves 28 VAV boxes in East Wing perimeter
WIEK S10	Constant Volume Multizone AHU with SF	4,075 cfm, 3 hp SF	HW and 2-stage DX cooling, hot deck-cold deck, serves 6 zones in East Wing interior.
WIEK S11	Constant Volume AHU with SF	10,500 cfm, 7.5 hp SF	Steam and 2-stage DX cooling, serves metal shop.
WIEK S12	Constant Volume AHU with SF	Unknown	Steam preheat and CHW, serves print shop.
WIEK S13	Constant Volume AHU with SF	2,920 cfm, 1.5 hp SF	Steam and 1-stage DX cooling, serves room B133.
WIEK S15	VAV AHU with SF with VFD	Unknown	Steam and CHW, serves 4 VAV boxes in room 302.
WIEK S16	Constant Volume AHU with SF	Unknown	Steam and CHW, serves room 301.
WIEK S17	VAV AHU with SF with VFD	3,200 cfm, 0.5 hp SF	Preheat and CHW, face/bypass, serves 5 VAV boxes in Upward Bound area.
WIEK S18	Constant Volume AHU with SF and EF	Unknown	Steam and 2-stage DX cooling, serves Plumbing shops.
WIEK RT1	Constant Volume RTU with SF	5,500 cfm, 5 hp SF	Steam and 2-stage DX cooling, serves Interior Design.
WIEK RT2	VAV RTU with SF with VFD	3,500 cfm, 0.5 hp SF	Steam and 2-stage DX cooling, serves 8 VAV boxes in Security Offices.
WIEK RT6	VAV RTU with SF with VFD	3,000 cfm, 2 hp SF	2-stage DX cooling, serves 5 VAV boxes in Construction Management.
WIEK RT23	Constant Volume RTU with SF	4,800 cfm, 3 hp SF	2-stage DX cooling, serves Business Office.

HVAC Equipment Cont'd- Wiecking Center

Description	Type	Size	Notes
WIEK RT4	Constant Volume RTU with SF	2,300 cfm, 1.5 hp SF	2-stage DX cooling, serves Plant Office.
55 VAV boxes			Majority do not have reheat
CHWP	Constant Volume CHWP	Unknown	
P-1, P-2, P-3, P-4	Variable Volume HWPs	Unknown	
4 Steam to HW HX	Steam to HW Converters		
P-1, P-2	Variable Volume HW Pumps		Serve AHU SF9
FTR			Unknown if it is HW or steam.
11 CUHs	Cabinet Unit Heaters		

Points on BAS

Description	Points
WIEK SF1	Occ/Unocc status, SF status, MAT, Econ damper position, DAT, Calc DAT, Heating valve, Face/bypass damper position, Cooling valve, Room temps, Average zone temp, Zone setpoint, RAT, RARH
WIEK SF2	Occ/Unocc status, SF status, MAT, Econ damper position, Minimum OA damper position setpoint, OA FPM, OA CFM, DAT, Heating valve, Cooling valve, Zone temp, Zone setpoint, SF VFD speed, RARH, Dehumidification setpoint, Auditorium CO2 ppm, RAT
WIEK SF3	SF status, Damper position, Store room temp, Night zone setpoint
WIEK SF5	Occ/Unocc status, SF status, DSP, DSP setpoint, SF VFD speed, MAT, Econ damper position, DAT, Calc DAT, Heating valve, Face/bypass damper position, Cooling stage 1 status, Cooling stage 2 status, Dehumidification setpoint, Average zone temp, Zone setpoint, RARH, RAT, OA CFM
WIEK SF9	SF status, Day/night status, DSP, DSP setpoint, SF VFD speed, MAT, Econ damper position, DAT, DAT setpoint, Heating valve, RAT, Cooling stage 1 status, Cooling stage 2 status, Pneumatic stats day/night
WIEK S10	SF status, Day/night status, MAT, Econ damper position, Hot deck DAT, Hot deck calc DAT, Heating valve, Cold deck DAT, Cold deck calc DAT, RAT, Cooling stage 1 status, Cooling stage 2 status, EF status, Zone temps, Zone temp setpoints, Zone damper positions
WIEK S11	SF command, SF status, MAT, MA damper %, Economizer mode, DAT, DAT setpoint, Heating valve %, RAT, Cooling stage 1 and 2
WIEK S12	Occ/Unocc status, SF command, SF status, Low limit alarm, MAT, MA damper%, Economizer mode, DAT, DAT setpoint, Cooling stage 1 and 2, Dehumidify setpoint, RAT, Preheat face/bypass %, Preheat valve %, Preheat temperature, Reheat valve %, Zone temperature, Zone temperature setpoint, RARH, Humidity setpoint, Humidity valve %
WIEK S13	Occ/Unocc status, SF status, Low limit alarm, MAT, MA damper %, Economizer mode, DAT, Heating valve%, Radiation valve %, RAT, Cooling stage 1, Zone temperature, Zone temperature setpoint, Zone cooling setpoint
WIEK S15	Occ/Unocc status, SF command, SF status, Low limit alarm, MAT, MA damper %, Economizer status, DAT, DAT setpoint, Heating valve %, Cooling valve %, Average zone temperature, Static pressure, Static pressure setpoint, SF speed

Points on BAS Cont'd- Wiecking Center

Description	Points
WIEK S16	Occ/Unocc status, SF command, SF status, Low limit alarm, MAT, MA damper %, Economizer status, DAT, Radiation valve%, Heating valve%, Cooling valve%, Zone temperature, zone temperature setpoint
WIEK S17	Occ/Unocc status, SF command, SF status, Low limit alarm, Aux OA damper status, Static pressure, Static pressure setpoint, SF speed, MAT, MA damper %, Calculated OA damper position, Minimum OA damper position, Economizer status, DAT, Calculated DAT heating, DAT low limit heating, Preheat valve %, Preheat face/bypass, Cooling valve %, RAT, RARH, Space temperature, Space temperature setpoint, CO2
WI VFD17	VFD speed, VFD current, VFD torque, VFD rated power, VFD drive temperature, VFD kWh, VFD MWH, VFD drive fault status, VFD panel lock
WIEK S18	Occ/Unocc status, SF command, SF status, Low DAT alarm, MAT, MA damper %, Economizer status, DAT, Heating valve %, Cooling stage 1 and 2, Zone temperature, Zone temperature setpoint, RAT, RARH, EF command, EF status, Space differential pressure, Space differential pressure setpoint, Relief damper command
WIEK RT1	Occ/Unocc status, SF command, DAT, Heating valve %, Cooling stage 1 and 2, RAT, RAT setpoint, Zone temperature
WIEK RT2	Occ/Unocc status, SF command, SF status, Low limit alarm, High static alarm, MAT, MA damper %, OA CFM, Calculated OA CFM, Economizer status, DAT, Calculated DAT heating, DAT low limit heating, Heating valve %, DX cooling stage 1 and 2, Zone temperature, Zone temperature setpoint cooling, Static pressure, Static pressure setpoint, SF speed, RAT, RARH, Dehumidification setpoint, Occupancy sensor
WIEK RT6	Occupied command, SF status, MAT, DAT, RAT, RAT setpoint, Duct static pressure, Duct static pressure setpoint, SF speed, DX cooling stage 1 and 2, Economizer mode
WIEK RT23	Occupied command, SF command, SF status, Cooling stage 1 and 2, Zone temperature, Zone temperature cooling setpoint, Calculated zone cooling setpoint
WIEK RT4	Occupied command, SF command, SF status, DAT, Zone temperature, Calculated zone temperature cooling setpoint, Zone damper, Cooling stage 1 and 2, OAT
VAV boxes	Room temp, VAV cfm, Heating valve (VAVs with HW reheat only)
Cooling System	CHWP status
Heating System	HWST, Calc HWST, Steam valve, OAT, Heating system OA enable setpoint, HWRT, Pump status, Pump VFD speed, Converter OA enable setpoint, HW DP, HW DP setpoint
FTR	Room temp, Room temp setpoint, Valve position
CUHs	Room temp, Room temp setpoint, CUH status

Additional Comments

- This 1-story building houses offices and classrooms.
- Chilled water and steam come from the Utility Plant.
- This building is on the Johnson Controls Metasys Building Automation System.

Potential Candidate Buildings

These buildings have potential for reducing energy use and may or may not be included in a future investigation.

Highland Center State ID# E26073S9362/ E26073S10202					
Area (sqft)	130,280	Year Built	1962/ 2002	Occupancy (hrs/yr)	6,370

HVAC Equipment

Description	**Type**	**Size**	**Notes**
HY SF2	Constant Volume AHU with SF and EF	Unknown cfm, 25 hp SF, 10 hp RF	Steam and CHW, heat recovery from exhaust air, serves locker rooms.
HY SF3	VAV AHU with SF and RF with VFDs	Unknown cfm, 20 hp SF, 0.5 hp EF	Steam and CHW, serves VAV boxes offices and training room.
HY SF4	VAV AHU with SF and RF with VFDs	Unknown cfm, 20 hp SF, Disconnected RF	Steam and CHW, serves VAV boxes in lobby and corridor.
HY SF5	VAV AHU with SF and RF with VFDs	Unknown cfm, 3hp SF	Steam and CHW, serves VAV boxes in room 2010. RF is disconnected and never used.
OTTO SF1	VAV AHU with SF and RF with VFDs	13,150 cfm, 20 hp SF, 7.5 hp RF	Steam and CHW, serves VAV boxes in the free-weights area.
OTTO SF2	Constant Volume AHU with SF and RF	5,595 cfm, 7.5 hp SF, 5 hp RF	Steam and CHW, serves locker rooms .
OTTO SF3	Constant Volume SF with VAV EF with VFD	29,000 cfm, 30 hp SF, 10 hp EF	Steam and DX cooling, serves pool.
OTTO SF4	VAV AHU with 15 SFs and 12 RFs with VFDs	46,000 cfm, 45 hp SF total, 18 hp RF total	Steam and CHW, this unit serves Otto Arena.
OTTO SF5	Constant Volume Rooftop Unit	14,080 cfm, 20 hp SF, 7.5 hp RF	*This unit is NOT on the BAS.*
6 VAV boxes			HW reheat coils
6 EFs		All less than 1 hp	
Pool HWP	Constant Volume HWP	5 hp	
CHWP	Variable Volume CHWP with VFD	5 hp	
HW FTR			Serves hallways

Points on BAS- Highland Center

Description	Points
HY SF2	Occ/Unocc status, SF status, EF status, MAT, DAT, DAT setpoint, Cooling valve, Heating valve, Heating coil face/bypass damper position, Heat recovery EA temp, RAT, Zone RH, RARH, RA dehumidify setpoint, Zone temp, Zone temp setpoint, OAT, DAT setpoint low limit, DAT setpoint high limit
HY SF3, HY SF4, HY SF5	Occ/Unocc status, SF status, SF VFD speed, MAT, Econ damper position, OA cfm, DAT, Preheat valve, Cooling valve, RAT, RF status, RF VFD speed, Zone temp, Zone setpoint, Heating OA lockout setpoint, Cooling OA lockout setpoint, Shared OAT, Shared OARH, Calc Enthalpy, Static pressure (HY SF3), Static pressure setpoint (HY SF3), VAV day/night control (HY SF3)
OTTO SF1	Occ/Unocc mode, SF status, DSP, SF VFD speed, MAT, Econ dampers, OA cfm, DAT, Heating valve, Face/Bypass damper position, Cooling valve, RF status, RF VFD speed, RAT, Space temp, OAT
OTTO SF2	Occ/Unocc mode, SF status, RF status, DAT, Calc DAT setpoint, OA face/bypass damper position, Heating valve, Steam coil face/bypass damper position, Cooling valve, RAT, RAT setpoint, Men's locker room temp, RARH, Dehumidify setpoint, EAT, OAT, DAT low limit, DAT high limit
OTTO SF3	Occ/Unocc mode, SF status, MAT, Econ damper position, MAT low limit setpoint, Min OA damper position, DAT, Calc DAT setpoint, Heating valve, OA face/bypass damper position, RAT, RAT setpoint, RARH, Dehumidify setpoint, EAT, EF status, EF VFD speed, Building static pressure, Building static setpoint, OAT, Cooling stage 1 enable, Cooling stage 2 enable, Cooling stage 3 enable, Cooling stage 4 enable, DAT low limit, DAT high limit, RAT high limit
OTTO SF4	Occ/Unocc, SF status, SF VFD speed, MAT, OA damper 1 position, OA damper 1 cfm, OA damper 2 position, OA damper 2 cfm, OA damper 3 position, OA damper 3 cfm, Relief air damper position, DAT, Heating valve, Heating face/bypass damper position, Cooling valve, RF 4A status, RF 4A VFD speed, RF 4B status, RF 4B VFD speed, RA CO2, RF 4A low static, RF 4B low static, RF 4A high temp, RF 4B high temp
VAV boxes	Room temp, VAV box cfm
EF	Fan status
Cooling System	CHWP status, CHWST, CHWRT, CHWRT setpoint, CHW building isolation valve, CHWDP, CHWDP setpoint, CHWP VFD speed, CHW bypass valve
Pool HX	Pool HWP status, Pool supply water temp, Pool HX steam valve, Pool return water temp, Pool calc supply temp
HW Radiation	Space temp, Heating valve

Additional Comments

- This 1-story building houses a swimming pool, locker rooms, and offices.
- This building is on the Johnson Controls Metasys Building Automation System, under the names of Otto Arena, Physical Education, and Athletic Center.
- Chilled water and steam come from the Utility Plant.

Highland North
State ID# E26071S10679

Area (sqft)	37,116	Year Built	1979	Occupancy (hrs/yr)	6,370

HVAC Equipment

Description	Type	Size	Notes
HLD GYM	VAV AHU with SF with VFD	30,000 cfm, 15 hp SF	Steam and CHW, serves VAV boxes in gymnasium.
HLD LOC	Constant Volume AHU with SF	10,000 cfm, 10 hp SF	Steam, serves the Women's Locker Room.
HLD HND	Constant Volume AHU with SF	21,000 cfm, 15 hp SF	Steam and CHW, serves Handball Courts.
HLD SF4	VAV AHU with SF and RF with VFDs	12,315 cfm, 30 hp SF, 5 hp RF	Steam and CHW, serves VAV boxes.
EF 8		Unknown	
EF 9		Unknown	
Steam to HW HX	Steam to HW Converter		

Points on BAS

Description	Points
HLD GYM	Occ/Unocc status, SF status, SF VFD speed, MAT, Econ damper position, Min damper position, Econ mode, DAT, DAT setpoint, Heating valve, Cooling valve, Schellberg gym temp, RAT RARH, RA CO2, SF cfm
HLD LOC	SF status, DAT, Cooling space temp setpoint, Heating space temp setpoint
HLD HND	Day/night status, SF status, HDT, HDT setpoint, Cooling space temp setpoint, Heating space temp setpoint
HLD SF4	Occ/Unocc status, SF status, MAT, Econ damper position, DAT, DAT setpoint, Heating valve, Cooling valve, RAT, DSP, DSP setpoint, SF cfm, SF VFD speed, RF VFD speed, Room temp
EF 8, EF 9	Damper position, EF status

Additional Comments

- This 2-story building houses office space, locker rooms, a gymnasium, and swimming pool.
- This building is on the Johnson Controls Metasys Building Automation System.
- Chilled water and steam come from the Utility Plant.

Myers Field House State ID# E26071S10301					
Area (sqft)	82,308	Year Built	2001	Occupancy (hrs/yr)	6,370

HVAC Equipment

Description	Type	Size	Notes
ATH SF1	VAV AHU with SF and RF with VFDs	Unknown cfm, 25 hp SF, 15 hp RF	Steam and CHW, serves VAV boxes in Northwest side of building
ATH SF2	VAV AHU with SF and RF with VFDs	Unknown cfm, 25 hp SF, 15 hp RF	Steam and CHW, serves VAV boxes in Northeast side of building.
ATH SF3	VAV AHU with SF and RF with VFDs	Unknown cfm, 25 hp SF, 15 hp RF	Steam only, serves VAV boxes in Southwest side of building. Operates during the winter only.
ATH SF4	VAV AHU with SF and RF with VFDs	Unknown cfm, 25 hp SF, 15 hp RF	Steam only, serves VAV boxes in Southeast side of building. Operates during the winter only.
ATH SF5	VAV AHU with SF and RF with VFDs	Unknown cfm, 10 hp SF, 5 hp RF	Steam and CHW, serves VAV boxes on second floor of building.
ATH SF6	VAV AHU with SF and RF with VFDs	Unknown cfm, 5 hp SF, 1.5 hp RF	Steam and CHW, serves VAV boxes on first floor of building.
53 VAV boxes			HW reheat
HWP 1, HWP 2	HWPs with VFDs	180 gpm each, 10 hp each	
CHWP 1	CHWP with VFD		This pump is not used.
EF1, EF2, EF4, EF5, EF6, EF7		Unknown HP	
Steam to HW HX	Steam to HW Converter		

Points on BAS- Myers Field House

Description	Points
ATH SF1, ATH SF2, ATH SF3, ATH SF4, ATH SF5, ATH SF6	Occ/Unocc status, SF status, SF VFD speed, MAT, Econ damper position, OA cfm (ATH SF1&2, HY SF3,4,5), DAT, Preheat valve, Cooling valve (all but ATH SF3&4), RAT, RF status, RF VFD speed, Zone temp, Zone setpoint, Heating OA lockout setpoint, Cooling OA lockout setpoint (all but ATH SF3&4), Shared OAT, Shared OARH, Calc Enthalpy, Static pressure (ATH SF6&HY SF3), Static pressure setpoint (ATH SF6&HY SF3), VAV day/night control (ATH SF6&HY SF3)
VAV boxes	Room temp, VAV box cfm
Heating System	HWST, HWST setpoint, HWRT, HW converter 1/3 valve, HW converter 2/3 valve, HW DP, HW DP setpoint, P1 VFD speed, P1 status, P2 VFD speed, P2 status, HW pump OA lockout, HWST reset high limit, HWST reset low limit, HW OAT high limit, HW OAT low limit, OAT, Shared OA humidity, Calc OA enthalpy, Occ/Unocc, Number valves call for heating
Cooling System	Chilled water available (yes/no), Chilled water needed (yes/no), CHWST, CHWRT, CHW DP, CHW DP setpoint, CHWP VFD speed, CHWP status, CHW OA lockout, CHWST setpoint, Occ/Unocc, OAT, OARH, OA enthalpy, OA dewpoint, Athletic CHWDP, Athletic CHWDP setpoint
EF1, EF2, EF4, EF5, EF6, EF7	EF status

Additional Comments

- This 1-story athletic facility houses office space, locker rooms, an indoor racing track, and practice space for softball, baseball, and tennis.
- This building is on the Johnson Controls Metasys Building Automation System, under the name "Athletic Center".
- This building is also known as the Student Athletic Facility (SAF).
- Chilled water and steam come from the Utility Plant.

Pennington Hall
State ID# E26071S168

Area (sqft)	17,514	Year Built	1986	Occupancy (hrs/yr)	6,370

HVAC Equipment

Description	Type	Size	Notes
PEN SF5	VAV AHU with SF and RF with VFDs	6,800 cfm, 5 hp SF	HW and CHW
10 VAV boxes			No HW reheat
CHWP 3	Variable Volume CHWP	Unknown	
2 CUHs	Cabinet Unit Heaters		

Points on BAS

Description	Points
PEN SF5	Occ/Unocc status, SF status, SF VFD speed, MAT, Econ damper position, OA cfm, DAT, Heating valve, Face/Bypass damper position, Cooling valve, RF status, RF VFD speed, RAT, Space temp, OAT
VAV boxes	Space temp, Flow
Cooling System	CHWP status, CHWST, CHWRT, CHWRT setpoint, CHW building isolation valve, CHW DP, CHW DP setpoint, CHWP VFD speed, CHWP bypass valve
CUHs	Space temp, Space temp setpoint, Status

Additional Comments

- This 2-story building houses gymnasiums, courts, and offices.
- Chilled water and steam come from the Utility Plant.
- This building is on the Johnson Controls Metasys Building Automation System.

Performing Arts Center / Andreas Theater Addition State ID# E26071S0764 / E26071S10500					
Area (sqft)	107,356	Year Built	1967/2000	Occupancy (hrs/yr)	6,370

HVAC Equipment

Description	Type	Size	Notes
PERF_SF1	VAV AHU with SF and RF with VFDs	14,580 CFM 15 HP SF 5 HP RF	Steam and CHW, serves Theater Room 186 and 281
PERF_SF2	VAV AHU with SF and RF with VFDs	12,810 CFM 10 HP SF 5 HP RF	Steam and CHW, serves Recital Halls 191 and 284
PERF_SF3	VAV AHU with SF and RF with VFDs	21,380 CFM 10 HP SF 7.5 HP RF	Steam and CHW, serves Lobby 273 and 3rd Floor
PERF_SF4	VAV AHU with SF and RF with VFDs	28,200 CFM 25 HP SF 10 HP RF	Steam and CHW, serves General Areas and Rooms 101 and 104
PERF_SF5	VAV AHU with SF with VFD	3,750 CFM 3 HP SF	Steam and CHW, serves Choral Room 110
PERF_SF6	VAV AHU with SF with VFD	4,500 CFM 3 HP SF	Steam and CHW, serves Band Room 109
PERF_SF7	VAV AHU with SF with VFD	11,820 CFM 10 HP SF	Steam and CHW, serves Stage and Scene Shop
AND_SF1	VAV AHU with SF and RF with VFDs	Unknown	Steam and CHW, serves Black Box Theater (Andreas Theater addition)
AND_SF2	VAV AHU with SF and RF with VFDs	Unknown	Steam and CHW, serves Black Box Offices (Andreas Theater addition)
53 VAVs	VAV boxes		HW Reheat
RADP1 RADP2	Constant Volume HW Pumps	125 GPM 3 HP	Circulate HW for Radiation
RHTP1 RHTP2	Constant Volume HW Pumps	220 GPM 5 HP	Circulate HW for VAV box reheats
CHWP	Constant Volume CHW Pump	800 GPM 25 HP	
CDWP	Constant Volume CDWP	855 GPM 15 HP	
HWP-1 HWP-2 (Andreas)	Constant Volume HW Pumps	Unknown	Andreas Theater addition
5 CUHs	Cabinet Unit Heaters	500-620 CFM	
7 PRVs	Powered Roof Ventilators	475-2,530 CFM < 1 HP	
2 PUHs	Powered Unit Heaters	415-1,840 CFM < 1 HP	
3 Steam to HW HX	Steam to HW Converters		

Points on BAS- Performing Arts and Andreas Theater

Description	Points
PERF_SF1 PERF_SF3	SF command, SF status, SF speed, Low limit alarm, RF speed, RF offset (from SF), MAT, MA damper %, Minimum damper position, MAT low limit setpoint, Economizer switch, DAT, cooling valve %, Cooling valve OAT disable, Heating valve %, Heating valve OAT disable, RAT, RARH, Space temperature, Space temperature setpoint, Unoccupied heating control
PERF_SF2	SF command, SF status, SF speed, Low limit alarm, RF speed, RF offset (from SF), MAT, MA damper %, Minimum damper position, MAT low limit setpoint, Economizer switch, DAT, cooling valve %, Cooling valve OAT disable, Heating valve %, Heating valve OAT disable, RAT, RARH, Humidity setpoint, Humidity Valve %, Space temperature, Space temperature setpoint, Unoccupied heating control
PERF_SF4	SF command, SF status, Static pressure, Static pressure setpoint, SF speed, Low limit status, MAT, MA damper %, Economizer status, DAT, Calculated DAT setpoint, DAT low limit, Heating valve %, Cooling valve %, RAT, RARH, RARH setpoint, Humidity valve %, VAV day/night control
PERF_SF5 PERF_SF6	SF command, SF status, SF speed, Low limit alarm, MAT, MA damper %, MAT low limit setpoint, Economizer status, DAT, Cooling valve %, Cooling valve OA disable temperature, Heating valve %, Heating valve OA disable temperature, RAT, RARH, Humidity setpoint, Humidity valve %, Space temperature, Space temperature setpoint, Unoccupied heating control
PERF_SF7	SF command, SF status, Static pressure, Static pressure setpoint, SF speed, Low limit status, MAT, MA damper %, Economizer status, DAT, Calculated DAT setpoint, DAT low limit, Preheat face/bypass %, Preheat valve%, Cooling valve %, RAT, RARH, RARH setpoint, EF #31 status, VAV day/night control
SF1_VFD SF3_VFD SF4_VFD	SF speed, SF current, SF torque, SF rated power, SF drive temperature, SF kWH, SF MWH, Drive fault status, SF panel lock, RF speed, RF current, RF torque, RF rated power, RF drive temperature, RF kWh, RF MWH, RF panel lock
SF2_VFD	RF speed, RF current, RF torque, RF rated power, RF drive temperature, RF kWh, RF MWH, RF panel lock
SF5_VFD SF6_VFD SF7_VFD	SF speed, SF current, SF torque, SF rated power, SF drive temperature, SF kWH, SF MWH, Drive fault status, SF panel lock
AND_SF1	Occupancy, SF command, SF status, RF status, Low DAT alarm, Hi/Lo static alarm, MAT, MA damper %, Economizer status, DAT, RAT, RAT setpoint, Space temperature, Heating valve %, Cooling valve %, SF and RF speed, Minimum fan speed, Filter status
AND_SF2	Occupancy, SF command, SF status, RF status, Low DAT alarm, Hi/Lo static alarm, MAT, MA damper %, OA CFM, Economizer status, DAT, DAT setpoint, Face & Bypass dampers, Preheat valve %, Cooling valve %, Static pressure, Static pressure setpoint, SF and RF VFD, Average zone temperature, RAT, Filter status,
VAV boxes	Space temperature, Flow
Reheat/Rad. System (PA)	HWST, Calculated HWST, steam valve %, Pump command, Pump status
Cooling System (PA)	CHW pump command, CHW pump status, CHW differential pressure, CHW differential pressure setpoint,
Chilled water loop (PA)	CHWRT, CHWRT setpoint, CHW loop valve
Radiation	Space temperature, Space temperature setpoint, Radiation valve
CUHs	Space temperature, Space temperature setpoint, CUH status

Additional Comments- Performing Arts and Andreas Theater
• This 3-story building houses offices, classrooms, theaters, and practice rooms. • This building is on the Johnson Controls Metasys Building Automation System • Chilled water and steam come from the Utility Plant. • Two air handlers, which serve the NE corner of the 1st Floor of the Performing Arts Center, are reportedly being replaced soon.

Taylor Center
State ID# E26071S0100

Area (sqft)	142,951	Year Built	2000	Occupancy (hrs/yr)	6,188

HVAC Equipment

Description	Type	Size	Notes
TAY SF1E	VAV AHU with 2 SFs with VFD and 1 RF	45,000 cfm, 60 hp SF, 10 hp RF	HW and CHW, serves the Arena Bowl.
TAY SF1W	VAV AHU with 2 SFs with VFD and 1 RF	45,000 cfm, 60 hp SF, 10 hp RF	HW and CHW, serves the Arena Bowl.
TAY SF2	VAV AHU with SF and EF with VFDs	3,000 cfm, 5 hp SF, 1.5 hp EF	HW and CHW, serves 8 VAV boxes in West offices.
TAY SF3	VAV AHU with SF and RF with VFDs	15,000 cfm, 20 hp SF, 7.5 hp RF	HW and CHW, serves 16 VAV boxes in lobby and VIP area.
TAY SF4	VAV AHU with SF and RF with VFDs	5,200 cfm, 7.5 hp SF, 2.5 hp RF	HW and CHW, serves 16 VAV boxes in East offices.
TAY SF5	VAV AHU with SF and EF with VFDs	8,850 cfm, 10 hp SF, 15 hp EF	HW and CHW, serves 11 VAV boxes in locker rooms.
TAY SF6	VAV AHU with SF and RF with VFDs	1,160 cfm, 2 hp SF, 0.75 hp RF,	HW and CHW, serves VAV boxes in weight room.
VAV boxes			Quantity is estimated at 50+. Nearly all have HW reheat.
TAY EFA	VAV Exhaust Fan	5 hp	Removes air from Arena Bowl
TAY EFB	VAV Exhaust Fan	5 hp	Removes air from Arena Bowl
EF 1, 2, 3, 4, 6, 7	Exhaust Fans	Less than 1 hp each	
HWP1	Constant Volume HWP	235 gpm, 7.5 hp	Serves TAY SF2 and SF5
HWP2	Constant Volume HWP	235 gpm, 7.5 hp	Serves TAY SF1, SF3, and SF4
HWP3, HWP4	Variable Volume HWPs with VFD	181 gpm each, 5 hp each	
10 Cabinet Unit Heaters			Serve entries and corridor areas.
3 Steam to HW HX	Steam to HW Converters		

Points on BAS- Taylor Center

Description	Points
TAY SF1E, TAY SF1W	Occ/Unocc status, SF statuses, RF status, SF VFD speeds, MAT, Econ damper position, Min Econ damper position, Econ mode, DAT, Heating valve, Cooling valve, RAT, RARH, Dehumidify setpoint, Space temp, Space temp setpoint, OAT, OARH, OA Enthalpy, OA dew point, RA CO2, RA CO2 setpoint
TAY SF2, TAY SF5	Occ/Unocc status, SF status, DSP, DSP setpoint, Space pressure, SF VFD speed, MAT, Econ damper position, Min Econ damper position, Econ mode, DAT, Heating valve, Cooling valve, RAT, RARH, RACO2, Space temp, Space temp setpoint, VAV day/night control, Heating OA lockout, Cooling OA lockout, EF status, EF VFD speed, OAT, OARH, OA Enthalpy, OA dew point
TAY SF3, TAY SF4, TAY SF6	Occ/Unocc status, SF status, DSP, DSP setpoint, Space pressure, SF VFD speed, MAT, Econ damper position, Min Econ damper position, Econ mode, DAT, Heating valve, Cooling valve, RF status, RF offset, RF VFD speed, RAT, RARH, RA CO2, VAV day/night control, Zone temp, Zone temp setpoint, Heating OA lockout, Cooling OA lockout, OAT, OARH, OA Enthalpy, OA dew point
EFA, EFB	EF status, EF VFD speed, Arena static pressure, Arena static pressure setpoint
VAV boxes	Space temp, VAV cfm, Room occ/unocc switch (locker room VAVs only)
Heating System	HWST, HWST setpoint, HWRT, HW converter valve, HWP status, HW OA reset high limit, HW OA reset low limit, HW occ reset high limit, HW occ reset low limit, HW unocc reset high limit, HW unocc reset low limit, Occ/Unocc, Building line pressure, OAT
Cooling System	CHW available (y/n), CHWST, CHWRT, OAT, OARH, OA Enthalpy, OA dew point
Cabinet Unit Heaters	Space temp, Status

Additional Comments

- This 2-story building houses offices, locker rooms, a weight room, a wrestling room, and a basketball court.
- This building is on the Johnson Controls Metasys Building Automation System.
- Chilled water and steam come from the Utility Plant.

Trafton East State ID# E26071S2194					
Area (sqft)	57,270	Year Built	1994	Occupancy (hrs/yr)	8,760

HVAC Equipment

Description	**Type**	**Size**	**Notes**
AHU 1	VAV AHU with SF and RF with VFDs	40,000 cfm, 60 hp SF, 10 hp RF	Steam and CHW, serves VAV boxes throughout the building.
AHU 2	VAV AHU with SF and RF with VFDs	40,000 cfm, 60 hp SF, 10 hp RF	Steam and CHW, serves VAV boxes throughout the building.
3 VAV boxes			HW reheat
EF2	Variable Volume EF with VFD	7.5 hp	
EF3	Constant Volume EF	1 hp	
EF4	Variable Volume EF with VFD	1.5 hp	
HWP 1, HWP 2	Constant Volume HWPs	85 gpm, 2 hp each	
8 CUHs	HW Cabinet Unit Heaters		
1 Steam to HW HX	Steam to HW Converter		
HW Radiation			

Points on BAS

Description	**Points**
AHU 1	SF status, RF status, Min OA cfm, Min OA damper position, MAT, Econ damper position, Preheat temp, Steam valve, Face/Bypass damper position, DAT, CHW valve, RAT, RARH, RARH setpoint, Humidifier valve, DSP, SF VFD speed, RF VFD speed, Building static pressure, OAT
AHU 2	SF status, RF status, Min OA cfm, Min OA damper position, MAT, Econ damper position, Preheat temp, Steam valve, Face/Bypass damper position, DAT, CHW valve, Humidifier valve, SF VFD speed, RF VFD speed
VAV boxes	Space temp, VAV cfm
Heating System	HWST, HWST setpoint, Steam valve, HWRT, HWP status, HWST setpoint low, HWST setpoint high, OAT at low HWST setpoint, OAT at high HWST setpoint
Cooling System	CHWST, CHWRT, Loop CHWRT, CHW loop valve, CHW DP, CHW DP setpoint

Additional Comments

- This 4-story building houses offices, laboratories, and classrooms.
- This building is on the Johnson Controls Metasys Building Automation System.
- Chilled water and steam come from the Utility Plant.

Trafton Science Center (North, South, and Center) State ID# E26071S1070					
Area (sqft)	224,864	Year Built	1972	Occupancy (hrs/yr)	8,760

HVAC Equipment

Description	Type	Size	Notes
AHU 1A	VAV AHU with SF and RF with VFDs	10,000 cfm, 15 hp SF, 5 hp RF	Steam and CHW, serves 8 VAV boxes in 1st flr of Center Trafton
AHU 1B	VAV AHU with SF and RF with VFDs	15,000 cfm, 20 hp SF, 7.5 hp RF	Steam and CHW, serves 1st flr of Center Trafton
AHU 2	VAV AHU with SF with VFD	5,108 cfm, 7.5 hp SF	100% OA, Steam and CHW, Face/Bypass, serves 5 VAV boxes in 1st flr of Center Trafton
AHU 3	VAV AHU with SF and RF with VFDs	11,500 cfm, 15 hp SF, 5 hp RF	Steam and CHW, serves 10 VAV boxes in 1st flr of Center Trafton
AHU 4	VAV AHU with SF and RF with VFDs	8,610 cfm, 7.5 hp SF, 3 hp RF	Steam and CHW, serves 7 VAV boxes in 3rd flr of Center Trafton
AHU 5	VAV AHU with SF with VFD	12,680 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 14 VAV boxes in 1st flr West side of North Trafton
AHU 6	VAV AHU with SF with VFD	13,370 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 13 VAV boxes in 2nd flr West side of North Trafton
AHU 7	VAV AHU with SF with VFD	15,800 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 16 VAV boxes in 3rd flr West side of North Trafton
AHU 8	VAV AHU with SF with VFD	15,400 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 16 VAV boxes in 1st flr East side of North Trafton
AHU 9	VAV AHU with SF with VFD	13,800 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 14 VAV boxes in 2nd flr East side of North Trafton
AHU 10	VAV AHU with SF with VFD	16,200 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 11 VAV boxes in 3rd flr East side of North Trafton
AHU 12	VAV AHU with SF with VFD	14,610 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 20 VAV boxes in 1st flr West side of South Trafton
AHU 13	VAV AHU with SF with VFD	15,950 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 17 VAV boxes in 2nd flr West side of South Trafton

HVAC Equipment Cont'd- Trafton Science Center

Description	Type	Size	Notes
AHU 14	VAV AHU with SF with VFD	14,500 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 26 VAV boxes in 3rd flr West side of South Trafton
AHU 16	VAV AHU with SF with VFD	14,850 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 16 VAV boxes in 1st flr East side of South Trafton
AHU 17	VAV AHU with SF with VFD	14,920 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 19 VAV boxes in 2nd flr East side of South Trafton
AHU 18	VAV AHU with SF with VFD	15,630 cfm, 20 hp SF	Steam and CHW, Face/Bypass, serves 17 VAV boxes in 3rd flr East side of South Trafton
AHU 20	VAV AHU with SF with VFD	9,720 cfm, 7.5 hp SF	Steam and CHW, serves Mechanical Rm of Center Trafton
AHU 21	VAV AHU with SF with VFD	8,663 cfm, 7.5 hp SF	100% OA, Steam and CHW, Face/Bypass, serves offices of Center Trafton
~200 VAV boxes			Most have HW reheat
Chiller	Water-cooled Chiller	400 Tons	Feeds into campus CHW loop, operated throughout the summer
Cooling Tower	Cooling Tower	1,200 gpm	VFD on fan
CHWP	Variable Volume CHWP	800 gpm, 50 hp	
CDWP	Variable Volume CDW Pump	1,200 gpm, 20 hp	
HWP 1, HWP 2	Variable Volume HWPs	120 gpm each, 5 hp each	
HWP 9	Constant Volume HWP	Unknown	Circulates HW to fin tube radiation
HWP 10, HWP 10A	Variable Volume HWP	280 gpm, 7.5 hp	Circulates HW to VAV box reheats
HWP 11	Constant Volume HWP	Unknown	Circulates HW to fin tube radiation
111 EFs	Mixture of Constant and Variable Volume Exhaust Fans	1 is 15 hp, 19 are 1-3 hp, rest are > 1 hp	*83 of the EFs are on the BAS.*
36 Lab Hoods		750-2,000 cfm each	
3 Steam to HW HX	Steam to HW Converters		One is for the VAV box reheats, one is for the baseboard radiation, and one is for the Greenhouse
HW FTR			

Points on BAS- Trafton Science Center

Description	Points
AHUs 1A, AHU 1B, AHU 3, AHU 4	RAT, RARH, RF status, RA cfm, RF frequency, RA DSP, RA DSP setpoint, Econ damper position, MAT, Heating valve, Cooling valve, SF status, DA cfm, SF frequency, DAT, DAT setpoint, DARH, DARH setpoint, DSP, DSP setpoint, Cooling space setpoint, Space temp, Heating space setpoint, Space RH setpoint, Occ/Unocc mode, Space enthalpy, Setpoint CO2 (AHU 1A only), Space CO2 (AHU 1A only), Building pressure setpoint, Building pressure
AHU 2, AHU 21	OA cfm, Face/Bypass damper position, Heating valve, Cooling valve, SF status, DA cfm, SF VFD speed, DAT, DAT setpoint, DARH, DARH setpoint, DSP, DSP setpoint, Space RH, Space RH setpoint, Occ/Unocc mode
AHUs 5-10, AHU 12, AHU 13, AHU 14, AHU 16, AHU 17, AHU 18	RAT, RARH, Econ damper position, MAT, Face/Bypass damper position, Heating valve, Cooling valve, DA cfm, SF Frequency, SF status, Humidifier valve, DAT, DAT setpoint, DARH, DARH setpoint, DSP, DSP setpoint, Average building temp, Building temp setpoint, Space enthalpy, OA enthalpy, Face/Bypass damper position, Occ/Unocc mode, Building static pressure
AHU 20	RAT, Econ damper position, MAT, Heat/Cool valve, SF status, SF frequency, DA cfm, DAT, DAT setpoint, DSP, DSP setpoint, Room temp, Room temp setpoint, OA enthalpy, Occ/Unocc mode
VAV boxes	Room temp, Cooling setpoint, Heating setpoint
EFs	EF status, EF cfm, EF cfm setpoint, EF VFD speed (not all), DSP (not all), DSP setpoint (not all)
Heating System	Steam valve, HWP status, HWP speed, HWST, HWST setpoint, HW DP, HW DP setpoint, HWRT
Cooling System	CWST, CHW DP, CHW GPM, CHW GPM setpoint, CHWP status, CHWP VFD speed, CDWP status, CDWP VFD speed, CDW GPM, CDW GPM setpoint, CDW supply pressure, CDW return pressure, Bypass valve, CDWST, CDWRT, Tower fan status, Tower fan VFD speed, Tower setpoint temp

Additional Comments

- This 3-story building houses laboratories, offices, and classrooms.
- This building is on the Andover Building Automation System.
- Chilled water and steam come from the Utility Plant.
- There are plans to install a second 400 Ton chiller in the basement.

Wigley Administration
State ID# E26071S1177

Area (sqft)	48,933	Year Built	1979	Occupancy (hrs/yr)	2,340

HVAC Equipment

Description	Type	Size	Notes
SF1	VAV AHU with SF and RF with VFDs	20,000 cfm, 30 hp SF, 5 hp RF	HW and CHW, serves approximately 35 VAV boxes in South side of building.
SF2	VAV AHU with SF and RF with VFDs	20,000 cfm, 30 hp SF, 5 hp RF	HW and CHW, serves approximately 35 VAV boxes in North side of building.
70 VAV boxes			HW reheat coils, quantity is approximate.
P1	Variable Volume HWP with VFD	45 gpm, 1 hp	Serves HW reheats
P2	Constant Volume HWP	60 gpm, 2 hp	Serves VAV boxes
HWP	Constant Volume HWP	1.5 hp	Serves VAV boxes
CHWP	Constant Volume CHWP	Unknown	No longer used.
HW FTR			
4 CUHs	Cabinet Unit Heaters		
2 Steam to HW HX	Steam to HW Converters		

Points on BAS

Description	Points
SF1, SF2	Occ/Unocc status, SF status, RF status, MAT, Econ damper position, OA cfm reading, Min OA cfm setpoint, Econ mode, DAT, DAT setpoint, Heating valve, Cooling valve, Lowest VAV zone temp, RAT, RARH, RA Enthalpy, DSP, DSP setpoint, SF VFD speed, RF VFD speed
VAV boxes	Space temp, VAV cfm
HW FTR	Space temp, Space temp setpoint, Valve position
Heating System	North OAT, OA P1 enable setpoint, P1 status, North radiation HWST, Radiation HWST setpoint, HX valve, OA P2 enable setpoint, P2 status, South radiation HWST, South radiation valve, Reheat HWST, Reheat HWST setpoint, Reheat valve, Reheat HWRT, Reheat HW DP, Reheat HW DP setpoint, P1 VFD speed
Cooling System	P3 status
Cabinet Unit Heaters	Space temp, Space temp setpoint, Valve position

Additional Comments

- This 3-story building houses office space.
- This building is on the Johnson Controls Metasys Building Automation System.
- Chilled water and steam come from the Utility Plant.

Wissink Hall
State ID# E26071S1786

Area (sqft)	65,725	Year Built	1987	Occupancy (hrs/yr)	3,900*

HVAC Equipment

Description	Type	Size	Notes
CLRM SF1	VAV AHU with SF with inlet guide vanes	20,000 cfm, 20 hp SF	CHW only, serves 1st floor computer room.
CLRM SF2	VAV AHU with SF with inlet guide vanes	18,500 cfm, 20 hp SF	CHW only, serves 2nd floor.
CLRM SF3	VAV AHU with SF with inlet guide vanes	11,500 cfm, 10 hp SF	CHW only, serves 3rd floor.
~70 VAV boxes			HW reheat coils
P1 (HW)	Constant Volume HWP	220 gpm, 5 hp	
P2 (HW)	Constant Volume HWP	125 gpm, 3 hp	
P1 (CHW)	Constant Volume CHWP	800 gpm, 25 hp	
P2 (CHW)	Constant Volume CHWP	Unknown	
CDWP	Constant Volume CDWP	855 gpm, 15 hp	
2 Steam to HW HX	Steam to HW Converters		
EF	Constant Volume EF	2 hp	

Points on BAS

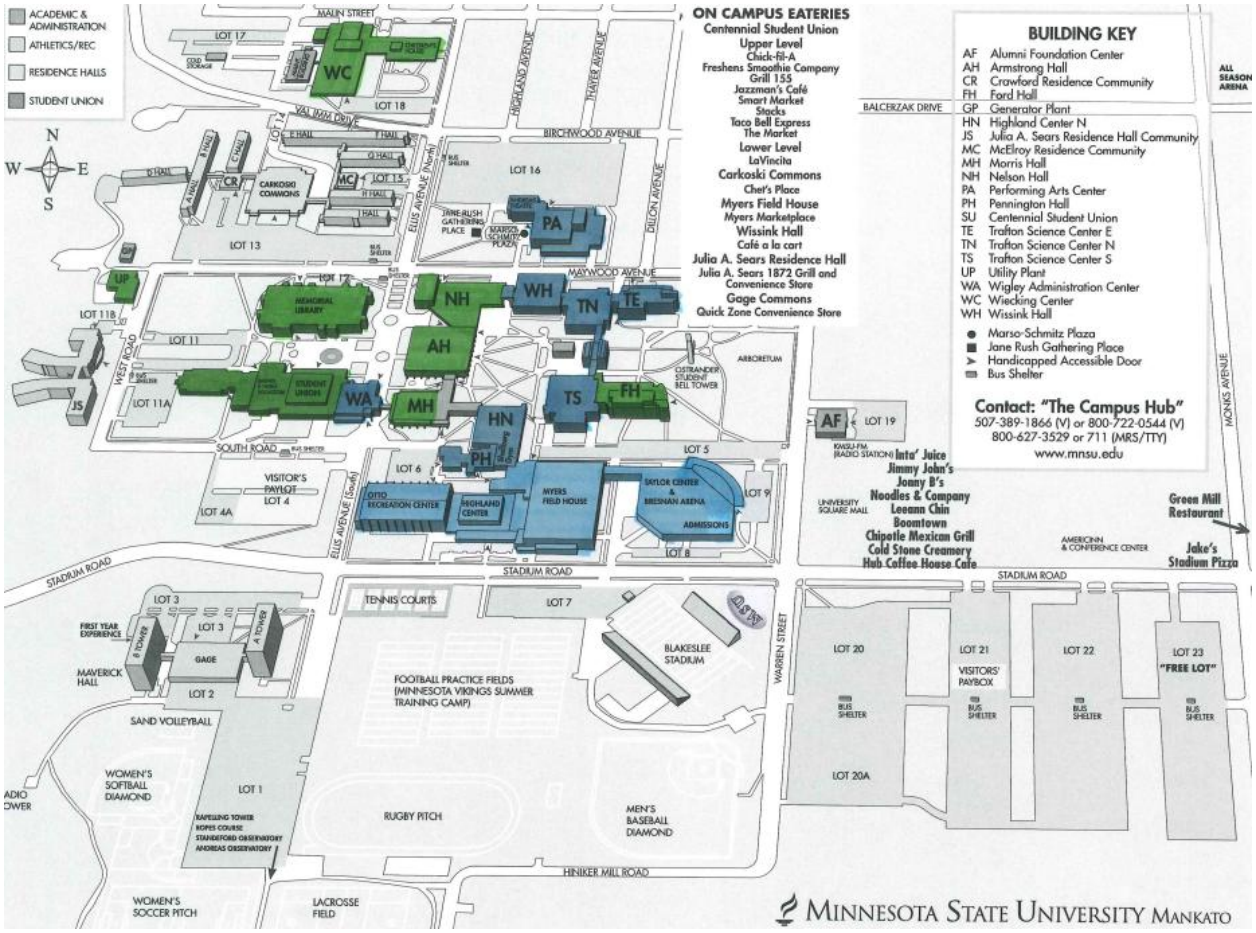
Description	Points
CLRM SF1, CLRM SF2, CLRM SF3	Occ/Unocc status, SF status, MAT, Econ damper position, DAT, DAT setpoint, Cooling valve, DSP, DSP setpoint, SF vane position, Zone temp, RAT, Summer/Winter status
VAV boxes	Space temp, VAV cfm
Heating System	HWST, Calc HWST setpoint, Steam valve, Lead Pump, OAT HWP enable, HWP status
Cooling System	CHWST, CHWRT, CHWP status

Additional Comments

- This 3-story building houses a computer center, office space, and classrooms.
- This building is on the Johnson Controls Metasys Building Automation System.
- Chilled water and steam come from the Utility Plant.

*This occupancy is for only portions of the building. The Nursing area is open 3 hours less per day and the computer center is open 24/7.

Campus Map



NOTE: The Phase 1 Buildings are highlighted in green, the Potential Candidate Buildings are highlighted in blue, and the Poor Candidate Buildings are not highlighted.

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HP	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CV	Constant Volume	MAT	Mixed Air Temperature
DA	Discharge Air	MAU	Make-up Air Unit
DA Enth	Discharge Air Enthalpy	OA	Outside Air
DARH	Discharge Air Relative Humidity	OA Enth	Outside Air Enthalpy
DAT	Discharge Air Temperature	OARH	Outside Air Relative Humidity
DDC	Direct Digital Control	OAT	Outside Air Temperature
DP	Differential Pressure	Occ	Occupied
DSP	Duct Static Pressure	PTAC	Packaged Terminal Air Conditioner
DX	Direct Expansion	RA	Return Air
EA	Exhaust Air	RA Enth	Return Air Enthalpy
EAT	Exhaust Air Temperature	RARH	Return Air Relative Humidity
Econ	Economizer	RAT	Return Air Temperature
EF	Exhaust Fan	RF	Return Fan
Enth	Enthalpy	RH	Relative Humidity
ERU	Energy Recovery Unit	RTU	Rooftop Unit
FCU	Fan Coil Unit	SF	Supply Fan
FPVAV	Fan Powered VAV	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH